PREMATURE AND HIGH-RISK BIRTH AND ACADEMIC PERFORMANCE IN KINDERGARTEN

By

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A DISSERTATION PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN
PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

UNIVERSITY OF FLORIDA

1987

This dissertation is dedicated to my husband, Bob Gould, who gave me the encouragement and belief in myself to complete this dissertation, and to Roxanna Gould, who has given me the final impetus to complete this dissertation in a timely manner.

ACKNOWLEDGMENTS

Gratitude is expressed to Dr. Larry Loesch, committee chairperson, and the committee members, Dr. Janet Larsen and Dr. Michael Resnick, for their support, guidance, and inspiration and to the Alachua County School Board for their cooperation and assistance in data collection.

Gratitude is also expressed to other professors for their collective support in my undertaking and completing this study.

Thanks are extended to my family, Anne, Gene, Bernice, Larry, Andy, Carol, Eric, Amy, and Heidi for their loving support and understanding. Heartfelt thanks are extended to my friends, Herb, Nancy, Rosemarie, Bill, Carla, Virginia, Doreen, and Tom for their encouragement and advice. Barbara's excellent typing skills and Gail's assistance with the computer are greatly appreciated.

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Abstract of Dissertation Presented to the Graduate School of the University of Florida in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy

PREMATURE AND HIGH-RISK BIRTH
AND ACADEMIC PERFORMANCE IN KINDERGARTEN

By

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December 1987

Chairperson: Larry Loesch
Major Department: Counselor Education

The primary purpose of this study was to investigate the relationship between the kindergarten performance, as measured by the Metropolitan Readiness Test (MRT), and selected family and child variables of a sample of premature and high-risk children attending public school in Alachua County, Florida. A second purpose was to compare the premature and high-risk children to the general public school population of Alachua County, Florida, in regard to MRT scores, frequency of gender and ethnicity in kindergarten enrollment, rate of special education placement, rate of retention, and rate of absenteeism. All of the 130 premature and high-risk children were enrolled in public school in Alachua County, Florida.

Family variables included maternal age at the time of the child's birth, maternal level of education at the time

of the child's birth, and parental income at the time of the child's birth. The variables selected for the premature and high-risk children included ethnicity, gender, number of days of hospitalization during the newborn period, and birth weight. The data were analyzed by multiple regression analyses, one-way analyses of variance, and chi-square procedures.

Analyses revealed that premature and high-risk children had academic achievement which was comparable to the general public school population as measured by the Metropolitan Readiness Test. However, 43% of the premature and high-risk children were placed in special education programs as compared to 13.3% of the general public school population of Alachua County. Significantly more ($p < .05$) premature and high-risk children were placed in programs for the trainable mentally handicapped and the physically impaired and in speech and langauge therapy than was the general public school population. Further, the family variables of maternal educational level and parental income were significantly related to academic achievement on the Metropolitan Readiness Test. The premature and high-risk children's ethnicity and birth weight were also significantly related to academic performance on the Metropolitan Readiness Test. The results of the study reflected that the biological status of premature and high-risk children in conjunction with certain familial factors influence later school performance in kindergarten.

CHAPTER I
INTRODUCTION

Johannes Keppler

Sir Isaac Newton

Pablo Picasso

Anna Pavlova

Sir Winston Churchill

Franklin Delano Roosevelt

What do these famous people have in common? They shared the perils of premature birth or severe illness shortly after birth (Raju, 1983). Their subsequent achievements have, however, continued to spark the controversy surrounding the long-term effects for those with "complicated" births. The fundamental question has been, do babies who were unusually small or ill soon after birth grow up to be dull, incapable individuals or do they develop into productive members of society?

As advances in modern medicine have increased the ability to sustain life, what has been the impact of those advances upon society? With specific reference to children who were born early (i.e., prematurely), of low birth weight, or with severe illness shortly after birth (i.e.,

high risk), what has been the impact for their educational services?

While advances in modern medicine have increased the life expectancy of children who have had a difficult course during their newborn periods, the children themselves may not be restored to a healthy condition. Many of the initial complications (e.g., difficulty breathing or irregular heart beat) of the premature, low-birth-weight or high-risk infant have been conquered by pharmaceutical or technological advances. Many of the children, however, continued to suffer from chronic, long-term disorders, such as cerebral palsy or severe lung diseases (Holt, 1972).

At one time, children with chronic disorders were treated and educated in state-funded institutions or in their own homes (Schroeder, Teplin, & Schroeder, 1982). However, as a result of the passage of P.L. 94-142 (The Education for All Handicapped Children Act) and the Department of Health, Education, and Welfare's Forward Plan for Health 1978-1982, most chronically ill children are educated in the public schools (Schroeder et al., 1982). The implementation of P.L. 94-142 has, therefore, led the way for members of the medical professions to work with educators to define and meet children's needs within educational settings (Schroeder et al., 1982). It is necessary for health and educational providers to share the information and skills which are unique to their professions because no one

profession can work alone to provide for children's needs. Children's individual needs are best served in this way.

Because of their knowledge of psychosocial development and their skills in working in an interdisciplinary team, school psychologists are frequently in the best position to serve as a liaison between schools and physicians (Schroeder et al, 1982). However,

> to be effective in this role, the school psychologist must have some basic understanding of medical problems and their effect on a child's psychosocial development. In general, the school psychologist's treatment and consultation work must take into account the health problems and medical needs of school children just as physicians must consider psychosocial development in their treatment of children. (Schroeder et al., 1982, p. 970)

Prematurity and Its Consequences

The majority of human births in the United States occur approximately 40 weeks after the mother's last menstrual period, with optimal birth weight between 3200 and 3800 grams (Robertson, 1979). Infants who are born before 37 weeks' gestation and who weigh less than 2500 grams are considered to be premature (Keller, 1981). The concept of prematurity carries the implication that there is a "developmental stage of interuterine fetal growth that could be considered an optimal time for the birth of a healthy infant" (Keller, 1981, p. 3). In 1983, infants who were born at 37 to 40 weeks gestation and who weighed over 2501 grams at birth comprised 93.2% of the live births in the

United States (United States Department of Commerce, 1985). Premature or low-birth-weight children (i.e., infants weighing less than 2501 grams at birth) made up 6.8% or 245,752 of the infants born in the United States in 1983 (United States Department of Commerce, 1985).

Infants who are born before 37 weeks' gestation are often considered to pose an increased probability of risk for present or future abnormalities in their physical, cognitive, or emotional developments (Keller, 1981). Accordingly, some assessments of an infant's functioning are made at the time of the child's birth. One such evaluation is the Apgar assessment which measures an infant's heart rate, respiratory effort, reflex irritability, muscle tone, and color (Illingworth, 1980). This assessment is made at periodic intervals during the first hour or more of life (Illingworth, 1980). Other tests (e.g., The Brazelton Behavioral and Neurologic Assessment Scale or The Neonatal Neurologic Examination) of neurologic and sensory functioning may be conducted during the first month of life.

The development of the premature, low-birth-weight and high-risk infant has been the focus for much research. As early as 1862, Little noted relationships among low birth weight, prematurity, Little's Disease (cerebral palsy), epilepsy, and mental retardation. Wall and Ylppo (cited in Benton, 1940) found that prematurely born children without serious neurologic problems demonstrated significant delays

in the emergence of such developmental "milestones" as sitting, walking, and language acquisition. However, they also found that after approximately 2 years of life, the majority of the children were functioning normally.

These observations led Gessell (1933) to argue for the use of an "adjusted chronological age" which calculated a child's age from the time of conception rather than from the date of birth. The correction for gestational age is an attempt to eliminate the presumed developmental lag due to prematurity in the assessment of a child's functioning. The implication for the correction or adjustment for gestational age is that deficits in development in early life will be followed by average functioning later in life (Caputo, Goldstein, & Taub, 1979). The statistical correction applied to the premature child "erases" or minimizes the deficits displayed in early life so that the child can be seen as functioning consistently from the perinatal period through middle childhood (Caputo et al., 1979, p. 220).

To test the hypothesis that delays in early childhood are followed by average functioning in later life, investigators have usually studied the premature child at school age (Cohen & Parmelee, 1983; Eames, 1945; Fitzhardinge, 1978; Fitzhardinge & Ramsay, 1973; Gunn, Lepore, & Outerbridge, 1983). Intellectual functioning, academic progress, and rate of school absenteeism have been the focus of much of this later research (Drillien, Thompson, &

Burgoyne, 1980; Drillien, 1958b; Drillien, 1959; Ehrlich & Shapiro, 1973; Stahlman, Hedval, Dolanski, Faxelius, Burdo, & Kirk, 1973; Weiner, 1968). The majority of the authors found that as improvements were made in neonatal management techniques, the incidence rates for severe handicapping conditions, such as blindness and profound mental retardation, decreased (Davies & Stewart, 1975; Drillien et al., 1980).

Jacob, Benedict, Roach, and Blackledge (1984) reviewed 30 years of literature concerning the later developments of premature children. They found support for the hypothesis that premature children continued to suffer learning problems at a higher rate than would be expected in a normal school population (Jacob et al., 1984). The majority of the researchers reported that the premature and high-risk children had an average intellectual quotient of 95 on traditional (i.e., mean of 100) measures of intelligence. Despite average intellectual functioning, however, the prematurely born children were more likely to have lower than average scores on arithmetic and reading achievement measures than did their "full-term" peers (Jacob et al., 1984). Additionally, the rate of special educational placement for the prematurely born children was higher than placement rates for the general school population (Jacob et al., 1984).

Drillien et al. (1980) reported that while 95% of the low-birth-weight children attended traditional schools in

the elementary grades, 8% were placed in special education programs. The rate was compared to a special education placement rate of 1% to 3% for the general school population (Drillien et al., 1980). Similar results were reported by Gunn et al. (1983) who found that 7% of the low-birth-weight infants in their investigation suffered a significant handicapping condition which required special educational placement.

Lilienfield and Parkhurst (1951) also were concerned with the relationship between early impairment and later development. They viewed the degree of impairment as part of a continuum of reproductive causality. They proposed a gradation of developmental outcomes from the most severe, e.g., miscarriage or neonatal death, to moderate conditions, such as cerebral palsy or seizures, to milder disabilities such as cerebral dysfunction or learning disabilities. Smith, Flick, Ferriss, and Sellman (1972) and Caputo et al. (1979) have proposed an extension to the continuum of reproductive causality: that the theory encompass the more subtle manifestations which occur in later functioning at school age. The implication of this viewpoint is that the adverse effects of prematurity may not be obvious in early life but may be linked to later difficulties encountered in academic or vocational achievement efforts (Caputo et al., 1979).

Bloom (1964) and Bruner (1960) have postulated that the preschool years are of particular importance in the development of the foundations essential for later school success. In discussing the developmental tasks of early childhood, Schroeder et al. (1982) stated "the main developmental goals . . . are motor coordination, cognition, attention span, speech and language" (p. 972). The period of development at the elementary school age focuses on physical and social growth towards independence (Schroeder et al., 1982). The school-age child is expected to use langauge in tasks which require abstract reasoning and to use symbolic forms of language in reading or mathematics (Schroder et al., 1982).

Drillien (1972b) noted that as the survival rates for high-risk infants increases, continued observation and evaluation is needed to assess the full impact of complications surrounding premature or high-risk birth as well as the impact for society in terms of continued need for medical, educational, and vocational support services. The impact of prematurity and high-risk birth has far-reaching implications for the children who survive, for their parents or custodians, for educators, and for taxpayers. As more children whose potential for future psychoeducational impairment survive, planning is necessary to allocate educational and vocational resources to meet their needs. Research efforts, therefore, should be directed to assist in

obtaining more accurate estimates of the number of individuals who will require special services as well as the types of services needed (Drillien, 1972b).

Limitations of the Previous Research

Historically, research concerning the long-term consequences of prematurity has yielded mixed results. Confusion exists as to the predictability of the long-term consquences of premature or high-risk birth. Caputo et al. (1979) stated that the "confusion in the literature is compounded by various factors: (1) the absence of a consensually agreed upon, and comprehensive definition of prematurity and (2) inadequate research design" (p. 221).

Researchers have employed a variety of definitions of prematurity for inclusion of infants in research studies. Parameters such as birth weight (Benton, 1940; Drillien, 1972a; McDonald, 1963; Paneth, Kiely, Stein, & Susser, 1981; Steiner, Sanders, Phillips, & Maddock, 1980), crown-heel or crown-rump length (Cassady, 1970; Crosse, 1945), gestational age and birth weight (Lubchenco, Delivoria-Popadoulos, & Searles, 1972; Silva, McGee, & Williams, 1984), head circumference (Broman, 1979; Lubchenco, 1970), and reflex responsivity (Chickermaine, Majumdar, & Shas, 1969) have been used to define various premature populations. As Caputo et al. (1979) noted, "although the various criteria of prematurity are intercorrelated, it is nevertheless true

that a child defined as premature in one study may not be so defined in another study employing a different criterion of prematurity" (p. 221).

Related to the use of varying criteria in the definition of prematurity is the differing criteria used to define handicapping conditions. Authors have used such criteria as institutional placement (Alm, 1953), mental retardation (Asher, 1946; Barlow, 1945; Dinwiddie, Mellor, Donaldson, Tunstall, & Russell, 1974), and placement in special educational programs (Drillien et al., 1980; Fitzhardinge, 1976; Fitzhardinge & Ramsay, 1973; Jacob et al., 1984) to describe handicapping conditions. Other authors have used conditions such as cerebral palsy (Bacola, Behrle, DeSchweinitz, Miller, & Mira, 1966a, b) or the term "major neurologic sequelae" (Commey & Fitzhardinge, 1979) as a means to define their handicapped populations. Again, a child defined as handicapped in one investigation would not necessarily be so defined in another. Thus, the rates for handicapping conditions in the prematurely born vary with authors' definitions of handicapping conditions.

In addition to the variety of conditions used to describe prematurity and its effects upon the child, flaws in the long-term research have been noted. Lubchenco (1983) cited errors in the research such as incomplete follow-up data and lack of statistical control for environmental factors. Weiner (1962) criticized the research for an

absence of theoretical bases and inadequate statistical interpretations of data. Other methodological shortcomings include use of subjective measures (Benton, 1940; Blegen, 1952; Ehrlich & Shapiro, 1973; Yu & Hollingsworth, 1979), use of small sample groups (Alden, Mandelcorn, Woodrum, Wennberg, Parks, & Hodson, 1972; Bacola et al., 1966; Commey, Ashby, & Fitzhardinge, 1978; Douglas & Gear, 1976; Howard, Worrell, & Colier, 1952), and incomplete demographic data (Asher, 1946; Koenig, 1950; Marriage & Davies, 1977).

The use of differing criteria for the initial selection of subjects and the use of various criteria for describing handicapping conditions, as well as methodological errors in the research have resulted in the long-term consequences of prematurity being poorly understood. Estimates of the incidence rate of severe handicapping conditions in premature or high-risk infants range from 4.6% (Paneth et al., 1981) to 6% (Fitzhardinge, Kalman, Ashby, & Pape, 1978; Stewart, Reynolds, & Lipscomb, 1981) to 14% (Dinwiddie et al., 1974; Outerbridge, Ramsay, & Stern, 1974). Some authors argue that the incidence rate for handicapping conditions has not changed since the 1950s (Drillien et al., 1980; Stewart et al., 1978), while others cite reductions in the incidence rate for handicapping conditions by as much as 50% (Resnick, Bauer, Cupoli, Ausbon, Evans, & Regionalized Perinatal Staff, 1983a). Therefore, it becomes difficult to

determine what effect, if any, prematurity or high-risk birth has on the future development of these children.

Theoretical Framework

The study of preterm or high-risk infants involves the evaluation of the influence of biological and environmental factors in the overall development of the child. Unger and Sigman (1983) pointed out that "an understanding of these [biological and environmental] factors is of theoretical importance for specifying the dynamics of human development and of practical importance for the accurate assessment of functioning in infants born prior to term" (p. 217).

Piagetian theory of intellectual development also incorporates the biological interaction between the child and the environment (Swanson & Watson, 1982). Related to the child's interaction with the environment are the principal structures and functions of intellectual development (Piaget, 1970). Variables such as heredity, maturation, experience, and social milieu are related to the child's interaction with the environment (Piaget, 1970).

According to Piaget, intellectual development is composed of four interrelated stages of cognitive growth (Swanson & Watson, 1982). The four principal stages of intellectual development are the sensorimotor stage, preoperational stage, concrete operations stage, and formal operations stage of intellectual development (Piaget, 1970).

Swanson and Watson (1982) noted "the stages are continuous, and each is built on and is a derivative of an earlier one" (p. 126).

In the sensorimotor stage of cognitive development, the child begins to acquire knowledge through motor actions that do not require use of symbolic language. The sensorimotor stage, therefore, is a time of general development in which a child, through reflexive movement, begins a process of discovery learning without the use of symbolic language (Swanson & Watson, 1982). As cognitive growth progresses, the child moves from using language in an egocentric manner to using language for communicative acts (Swanson & Watson, 1982). The child's thinking develops from transductive, egocentric thought to organized, logical thinking and then to the comprehension of abstract concepts which involves problem solving and hypothesis testing (Swanson & Watson, 1982).

In assessing the premature or high-risk child during early childhood, the sensorimotor and the initial phase of the preoperational stage of intellectual development are the focus. Severe and moderate handicapping conditions are usually detected during these early assessments (Drillien, 1972; Hunt, 1979). However, the less severe disabilities (which are functions of the increasingly more complex use of language, higher level reasoning tasks, and problem-solving

activities) may not be detected until school age (Hunt, 1979). As Drillien (1972a) noted,

> it is generally agreed upon that although many major handicaps that will render the child ineducable in the normal school can be recognized by the age of one to two years, the full extent of less serious impairments associated with low birthweight and other perinatal hazards cannot be assessed before six or seven years of age, when learning difficulties become apparent. (p. 575)

Statement of the Problem

The previous research investigating the relationship between early physical compromise (e.g., prematurity or neonatal illness) and subsequent development has suffered from a variety of limitations. Thus, conclusions from previous research remain unclear. Therefore, the current researcher attempted to avoid the limitations of the prior research efforts.

Currently, it is not known whether children born at risk continue to have an increased probability for delays in academic functioning at school age. While evidence suggests that the majority of children who were born at risk function normally once they reach 2 to 3 years of age, controversy exists as to their functioning within the traditional school setting. Many researchers have discontinued the study of premature or high-risk infants once they reach 2 to 3 years of age because they have believed that most significant handicapping conditions will have been identified by then. However, more subtle deficits in the use of problem-solving

strategies and abstract thought cannot be explored until the child reaches school age. Therefore, continued investigation into the relationship between early physical compromise (e.g., premature and high-risk birth) and later development is necessary for understanding the long-term consequences of premature and high-risk birth.

All of the children selected for the current investigation had been hospitalized during the newborn period due to complications arising from premature birth or due to illness shortly after birth. The children were school-aged at the time of the study. The relationship between school achievement in the areas of reading readiness, language skills, numerical concepts, rate of placement in special education programs (e.g., speech and language therapy), the rate of school absenteeism, and the rate of retention were compared to individual and family characteristics. Individual characteristics included the variables of race, sex, birth weight, and the number of days of hospitalization during the newborn period. The family characteristics encompassed the family's income at the time of the child's birth, the parent's level of education at the time of the child's birth, and the parent's age. These relationships were analyzed to assist in a more complete understanding of the long-term consequences for the development of school-age children who were prematurely born or who were ill shortly after birth.

Need for the Study

The expanded knowledge of the long-term consequences of prematurity contributes to theories of child development in the areas of physical, cognitive, and emotional growth. It has been frequently assumed that when correction for gestational age is made to account for the degree of prematurity, these children function no differently than do their full-term counterparts. However, researchers report that premature and other high-risk infants pose an increased probability for future developmental delay. With continued research efforts, the prediction of the long-term outcome of high-risk birth could be improved by knowing the incidence rate of handicapping conditions as well as knowing the various types of deficits which may occur in the high-risk population. Further, as advances in medicine contribute to the increased survival of very small, sick infants, research efforts can be directed to explore the impact that such survival has on the child, the family, and society. When prediction of the long-term consequences of prematurity are improved, the allocation of funds for educational programs and other assistance programs can be based on the prediction data.

Purpose

The primary purpose of this study was to investigate the relationship between the kindergarten performance, as

measured by the Metropolitan Readiness Test (MRT), and selected family and child variables of a sample of premature and high-risk children attending public school in Alachua County, Florida. A second purpose was to compare the premature and high-risk children to the general public school population of Alachua County, Florida, in regard to MRT scores, frequency of gender and ethnicity in kindergarten enrollment, rate of special education placement, rate of retention, and rate of absenteeism.

Measures such as the subjects' performance on academic achievement tests, rate of absenteeism, incidence rate of placement in special education classes, and rate of retention were compared to criteria set by the state of Florida.

Rationale for the Methodological Approach

Since 1975, preterm and seriously ill neonates in the state of Flordia have been provided with special care in the form of the Regional Perinatal Intensive Care Program (RPICP) which is under the auspices of Children's Medical Services (CMS). As part of the program, the participants are developmentally assessed at periodic intervals from birth until 5 years of age (Resnick et al., 1983a). A sample of children who were eligible for participation in the RPICP was selected for participation in the current study and their kindergaren records were analyzed.

The participants in the RPICP were selected because their birth and hospitalization data could be readily accessed for analysis. Children who were treated at Shands Teaching Hospital were selected as potential candidates for analysis. The participants in the study were selected from a group of high-risk or premature children at school age who completed kindergarten by the end of the 1984-1985 school year. The performance of the high-risk group was compared to the performance of the general school population at the same grade level. Because the majority of children in the United States of America are enrolled in public school programs, the children selected for study were enrolled in public school systems.

Research Questions

The following questions were applied to the high-risk children and their families:

1. What is the relationship between auditory skills on the Metropolitan Readiness Test (MRT) in kindergarten and the mother's level of education, the mother's age at the time of the child's birth, the child's birth weight, and the child's number of days of hospitalization during the newborn period?

2. What is the relationship between visual skills on the MRT in kindergarten and the mother's level of education, the mother's age at the time of the child's birth, the

child's birth weight, and the child's number of days of hospitalization during the newborn period?

3. What is the relationship between language skills on the MRT in kindergarten and the mother's level of education, the mother's age at the time of the child's birth, the child's birth weight, and the child's number of days of hospitalization during the newborn period?

4. What is the relationship between prereading skills on the MRT in kindergarten and the mother's level of education, the mother's age at the time of the child's birth, the child's birth weight, and the child's number of days of hospitalization during the newborn period.

5. What is the relationship between quantitative concepts on the MRT in kindergarten and the mother's level of education, the mother's age at the time of the child's birth, the child's birth weight, and the child's number of days of hospitalization during the newborn period?

6. What is the difference in the child's auditory skills on the MRT in kindergarten on the basis of the mother's marital status and income level at the time of the child's birth?

7. What is the difference in the child's visual skills on the MRT in kindergarten on the basis of the mother's marital status and income level at the time of the child's birth?

8. What is the difference in the child's language skills on the MRT in kindergarten on the basis of the mother's marital status and income level at the time of the child's birth?

9. What is the difference in the child's prereading skills on the MRT in kindergarten on the basis of the mother's marital status and income level at the time of the child's birth?

10. What is the difference in the child's quantitative concepts on the MRT in kindergarten on the basis of the mother's marital status and income level at the time of the child's birth?

The following research questions apply to high-risk children and the general school population:

11. What are the differences in auditory skills, visual skills, language skills, prereading skills, and quantitative concepts on the MRT in kindergarten between high-risk children and the general school population?

12. What are the differences between high-risk children and the general school population on the frequency of gender and ethnicity in kindergarten enrollment?

13. What are the differences in the rate of special education placements, rate of retention, or rate of absenteeism between high-risk children and the general school population during kindergarten?

The following research question applies to the high-risk children:

14. What are the differences in auditory skills, visual skills, language skills, prereading skills, and quantitative concepts on the MRT in kindergarten within the high-risk group on the basis of gender and ethnicity?

Definition of Terms

ABSENTEEISM--The number of days in which a child was not present at school during regular school hours during the school year. For purposes of the current study, the absence may have been either an excused or unexcused absence, and it may have included all or part of the school day.

APGAR SCORE--An assessment which is made by medical staff of an individual at periodic intervals shortly after birth. The Apgar score is based on heart rate, respiratory effort, reflex irritability, muscle tone, and color. Total scores of 8, 9, and 10 are considered good; scores of 3, 4, 5, 6, and 7 are rated as fair; while scores of 0, 1, and 2 are viewed as poor (Illingworth, 1980). Also, "the longer the score remains low, the worse the prognosis with regard to mortality or neurological sequelae" (Illingworth, 1980, p. 91).

BRONCHOPULMONARY DYSPLASIA--Chronic lung disease that develops in infants who have been treated with positive

pressure ventilation and/or exposed to elevated levels of inspired oxygen (Vohr, Bell, & Oh, 1982).

CLASSROOM PLACEMENT--Used in the current study to refer to the traditional classroom placement in a public school program.

FULL-TERM INFANT--A child who had a gestational period of 37 to 40 weeks prior to birth and who weighed 2500 grams or more at birth (Illingworth, 1980).

GESTATIONAL AGE--The length of interuterine fetal development measured in weeks from time of conception until birth. The optimal gestational age has been considered to range from 37 to 42 weeks with an optimal birth weight of 3000 to 4250 grams (Keller, 1981). In the industrialized nations, gestational age has been determined by neurologic examination which has been conducted shortly after birth (Keller, 1981).

HIGH-RISK INFANT--Children who were hospitalized in a neonatal intensive care unit due to prematurity or serious illness during the neonatal period. Due to the medical compromises sustained in the neonatal period, survivors have been considered to be at higher risk for subsequent developmental delay (Resnick et al., 1983).

HYALINE MEMBRANE DISEASE--

> This condition occurs when an infant is delivered prior to maturation of the enzymatic pathways in the lung which manufacture pulmonary surfactant (the largest component of which is lecithin). Lacking surfacant to stabilize the aveoli, the air sacs collapse on expiration, producing

> atelectosis. Because of the diffuse atelectosis, blood does not become fully oxygenated. (Berkow, 1982, p. 1758)

The condition is typically found in newborns of less than 37 weeks' gestation or in newborns weighing less than 2.2 kilograms (Berkow, 1982).

HYPERBILIRUBINEMIA--A condition of physiologic jaundice which, if untreated, may result in kernicterus. The condition is found in approximately half of all full-term infants and in a higher percentage of premature infants (Berkow, 1982).

INTRACRANIAL HEMORRHAGE--Refers to bleeding in or around the brain. Although the bleeding may occur in various sites, the severity of bleeding is related to magnitude and location, with large hemorrhages within the ventricles being the most serious and most common in premature infants during the first 3 days of life (Berkow, 1982).

KERNICTERUS--A condition associated with elevated bilirubin in the neonatal period. The condition is associated with choreoathetoid cerebral palsy, sensorineural hearing loss, loss of upward gaze, perceptual-motor handicaps, learning disorders, and developmental delay (Berkow, 1982).

LOW BIRTH WEIGHT--Infants who weigh less than 2500 grams at birth (Illingworth, 1980). "Low birth weight in relation to the duration of gestation may be due to malnutrition, abnormalities of the placenta, heredity or other factors" (Illingworth, 1980, p. 73).

METROPOLITAN READINESS TEST--A survey of early academic skills which provides an indication of a student's academic strengths and weaknesses (Nurss & McGauvran, 1976). The test is divided into five areas. They are as follows:

Auditory Skills--which includes two subtests, Beginning Consonants and Sound-Letter Correspondence. Beginning Consonants is purported to measure "the ability to discriminate among the initial sounds of words" (Nurss & McGauvran, 1976, p. 6). Sound-Letter Correspondence is purported to measure the ability to "identify letters corresponding to specific sounds in words" (Nurss & McGauvaran, 1976, p. 6).

Visual Skills--which is comprised of Visual Matching and Finding Patterns. Visual Matching is said to measure "visual-perceptual skill in matching letters, numerals, and letter-like forms" (Nurss & McGauvran, 1976, p. 6). Finding Patterns consists of the "ability to locate formations of letter groups, words, numerals, or artificial letters when embedded in larger groupings of similar content" (Nurss & McCauvran, 1976, p. 7).

Language Skills--which includes the subtests to School Language and Listening. School Language is comprised of the simple and complex grammatic structures which make up standard American English (Nurss & McGauvran, 1976, p. 7). Listening "measures the ability to integrate and reorganize

information, to draw inferences, and to analyze and evaluate material presented orally" (Nurss & McGauvran, 1976, p. 7).

The raw scores for each of the skill areas (auditory, visual, and language) are totaled to obtain the raw score for the prereading and reading readiness skills composite (Nurss & McGauvran, 1976, pp. 7-8).

Quantitative Concepts--comprised of Quantitative Concepts and Quantitative Operations. The skills measured in Quantitative Concepts include "number-numeral correspondence, conservation, part-whole relationships, and quantitative reasoning" (Nurss & McGauvran, 1976, p. 7). "Counting and simple mathematical operations such as addition and subtraction are measured" by the Quantitataive Operations Subtest (Nurss & McGauvran, 1976, p. 7).

PRETERM OR PREMATURE INFANT--Infants who are born before 37 weeks gestation and who weigh less than 2500 grams (Keller, 1981).

RETENTION--Children who have poor school attendance and/or children who did not make satisfactory academic achievement and have been retained for another year in the same grade. "In recent years, it is unusual for a student to be retained for more than one or two years in his [her] academic career. About 15 to 20 percent of public school students have been retained in recent years" (Light, 1981, p. 1).

RETROLENTAL FIBROPLASIA OR RETINOPATHY OF PREMATURITY--"A bilateral disease characterized by abnormality of the

retinal vessels that occurs in premature infants in whom the immature retina was exposed to high postnatal incubation oxygen concentrations" (Berkow, 1982, p. 2004). The infants affected usually weigh less than 1500 grams at birth. The disease is graded in terms of severity, with Grade I considered mild to Grade IV considered the most severe (Berkow, 1982). If the condition is mild, the abnormal vessels may regress and useful vision may result. If the condition is severe, retinal detachment may occur (Berkow, 1982). Other associated probems include myopia, glaucoma, and retinal detachment which can occur in the late teens or twenties (Berkow, 1982).

SMALL-FOR-GESTATIONAL-AGE OR SMALL-FOR-DATES INFANTS--Birth weight viewed in relationship to the infant's gestational age (Illingworth, 1980). Although there is variation in the amount a child would be expected to weigh at a given gestational age, there are optimal weights which physicians consider when weighing an infant (Illingworth, 1980). An infant may be small for dates and also be premature. The condition may be related to malnutrition, abnormalities of the placenta, heredity, or other factors (Illingworth, 1980). Illingworth noted, "The behaviour of the 'small-for-dates' baby is different at birth from the truely premature baby of the same birthweight, and . . . the prognosis with regard to subsequent mental and physical development is different" (Illingworth, 1980, p. 73).

SPECIAL EDUCATION PLACEMENT--Placement of a school-age child in a separate auxiliary educational program due to conditions such as mental retardation, learning disability, physical impairment, sensory deficit, emotional disorder, or speech and language disorder. The child may be placed in the program for all or part of the school day. Placement is determined on the basis of state and federal guidelines.

The following state guidelines were used to define certain handicapping conditions in the Alachua County Public School System:

Educable Mentally Handicapped--"One who is mildly impaired in intellectual and adaptive behavior and whose development reflects a reduced rate of learning" (School Board of Alachua County, 1985, p. 24). To qualify for placement, intellectual functioning generally must be no less than two but not more than three standard deviations below the mean on a standardized measure, and adaptive behavior must be below age and cultural expectations (School Board of Alachua County, 1985, p. 24).

Trainable Mentally Handicapped--"One who is moderately or severely impaired in intellectual and adaptive behavior and whose development reflects a reduced rate of learning" (School Board of Alachua County, 1985, p. 28). To qualify for placement, intellectual functioning must be no less than three but no more than five standard deviations below the mean on a standardized measure, and the adaptive behavior

must be below age and cultural expectations (School Board of Alachua County, 1985, p. 28).

Speech and Language Impaired--Disorders of language, articulation, fluency, or voice which interfere with communication, preacademic or academic learning, vocational adjustment or social adjustment" (School Board of Alachua County, 1985, p. 36).

Hearing Impaired--A hearing loss of 30 decibels or greater, pure tone average of 500, 1000, 2000 Hz, ANSI, unaided, in the better ear" (School Board of Alachua County, 1985, p. 41).

Visually Impaired--Disorders in the structure and function of the eye, even with the best correction and treatment, interfere with learning" (School Board of Alachua County, 1985, p. 48). One or more of the following conditions must exist for placement: (a) visual acuity of 20/70 or less in the better eye after correction, (b) constricted visual field which adversely affects learning, or (c) a progressive loss of vision.

Physical Impairment--"A physically disabling condition or other health impairment which requires an adaptation to the student's school environment or curriculum" (School Board of Alachua County, 1985, p. 53). Students qualify for the program if they have an impairment which "substantially limits one or more of their major life activities and have 1) muscular or neuromuscular handicaps which limit the

ability to sit, move about, or manipulate materials used for learning; 2) skeletal deformation or abnormalities which affect ambulation, posture, and body use; or 3) disabilities which result in temporary or chronic loss of strength, vitality, or alertness" (School Board of Alachua County, 1985, p. 53.).

Emotionally Handicapped--"A condition resulting in persistent and consistent maladaptive behavior which exists to a marked degree, which interferes with the student's learning process" (School Board of Alachua County, 1985, p. 57).

Gifted--"One who has superior intellectual development and is capable of high performance. The mental development of a gifted student is two standard deviations or more above the mean on a standardized intellectual measure" (School Board of Alachua County, 1985, p. 70).

VERY LOW BIRTH WEIGHT--Children born with birth weights of less than 1501 grams (Kitchen, Ryan, Rickards, McDugall, Billson, Keir, & Naylor, 1980; Jacob et al., 1984). It is estimated that very low-birth-weight infants comprise approximately 1% of all live births (Davies & Stewart, 1975).

Organization of the Remainder of the Study

The remainder of the study has been organized into four chapters. Chapter II contains a review of the literature

related to the scholastic and intellectual functioning of children at school age who were high-risk or premature infants at birth. A discussion of the research methodology and data-collection procedure is contained in Chapter III. The results of the study are presented in Chapter IV. Chapter V contains a summary which includes the conclusions made from the investigation and recommendations for further research.

CHAPTER II
REVIEW OF THE RELATED LITERATURE

High-risk Infants and Later Outcomes

Introduction

This review of the related literature focuses on developmental outcomes of follow-up investigators of high-risk infants as related to perinatal care. Because changes in medical management have been dramatic, have played a crucial role in the lives of high-risk infants, and have definable periods of evaluation, the review is divided into five time periods. They have been selected on the basis of differences in medical management that influenced not only infant mortality but also long-term morbidity rates.

1800 to 1940

Alm (1953) reported that Ritter, in 1849, was the first investigator published in the medical literature to associate prematurity with mental deficiency. Somewhat later, Little (1862) published a book entitled On the influence of abnormal partuition, difficult labors, premature birth and asphixia neonatorum on the mental and physical condition of the child, especially in relation to deformities (cited in

Alm, 1953). Within this book, Little hypothesized that there was a relationship between Little's Disease (cerebral palsy), epilepsy, and mental deficiency and low birth weight.

During the early twentieth century, several medical reports were published concerning high-risk infants and their later outcomes. In 1911, Wallich and Fruhinholz (cited in Benton, 1940) sent questionnaires to physicians concerning the current status and developmental histories of prematurely born children who were in their care. Prematurity was defined by the authors as a gestational period of less than 9 months as reported by the child's mother. The 143 children thus identified were further divided on the basis of birth weight into four groups. Their birth weights ranged from less than 1500 grams to 3000 grams. The physicians were also instructed to compare the premature children to their full-term siblings whenever possible. The authors concluded that the degree of prematurity was related to the degree of disability. The smaller birth-weight children had more unfavorable outcomes than did the larger birth-weight children. It was further noted that obstetrical trauma may have influenced the etiologies and outcomes of these children.

In 1913, Wall (cited in Benton, 1940) studied 183 premature children born between 1892 and 1910 in Berlin, Germany. The criterion for prematurity was a gestational

age of less than 9 months as reported by the mother. Of the 691 preterm infants born during this time, 492 survived beyond the first year of life. Two hundred of them were traced by Wall, and 57 were selected for follow-up investigation. An evaluation of the mental status of these children was based on Wall's clinical impression, school progress as reported by the child's teacher, and a questionnaire which was completed by the mother. Wall concluded that in comparison to full-term children, walking in premature children was delayed by an average of 6 months. He found that speech or language development also was delayed, by an average of 7-1/2 months. Of the children who were school age at the time of the study, all were attending traditional school programs. Wall's results indicated that the children who were most delayed in speaking also did poorly in school. Wall noted, however, that in light of the overall school performance of prematurely born children, delays noted in early childhood were overcome by a majority of the children by school age.

Ylppo (cited in Benton, 1940) published a series of studies in 1919 that concentrated on physiologic and clinical aspects of prematurity as well as the mental developments of the prematurely born child at school age. Of 988 children who were born in Berlin during 1910 to 1918, 320 died during the first year of life. Of the 668 survivors, 598 were available for follow-up investigation. In contrast

to Wall, Ylppo found a 7.4% rate of "idiocy" and "imbecility" and a 3.1% rate of Little's Disease (i.e., cerebral palsy) among his subjects. Ylppo concluded that despite early deficits, the majority of the children were functioning normally by the age of 5 or 6 years.

During the 1920s and the 1930s, research studies on developmental outcomes of prematurely born children were published in both the United States and Europe. European authors such as Baedorf in 1938, Levy in 1928, and Schoberlien in 1938 (cited in Benton, 1940) reported on the progress of premature children at school age. Although the majority of the children were reported to be performing satisfactorily in school, behavior problems were noted. For example, Baedorf, in 1938, (cited in Benton, 1940) described the children as displaying abnormal restlessness, nervousness, and fatigability that resulted in distractibility and disturbed concentration (which was often confused with a disturbance in intellectual functioning).

Capper (1928a, b) studied 103 children who were born in Vienna, Austria, between 1911 and 1926 and found the majority of the children to be physically and mentally underdeveloped. He concluded that the immature infant became the "backward" school child and was a likely candidate for institutionalization for mental retardation or other "psychiatric" reasons.

In the United States, Rosanoff and Inmann-Kane (1934) tested 140 prematurely born children with the Terman Scales to assess cognitive functioning. Twenty-eight percent of the subjects had an intellectual quotient of less than 85. However, they concluded that although prematurity was an etiological factor in mental retardation, it was not the only factor. They noted that mental retardation was usually associated with birth injury but that premature infants sustained a higher proportion of injury at birth than did full-term infants. Thus, prematurity was not a primary cause of mental retardation to Rosanoff and Inmann-Kane.

The first investigation that formally employed a control group, and corrected for gestational age, was conducted by Morh and Bartelme (1934). The subjects were comprised of 250 prematurely born children and 152 full-term siblings. The authors found no differences in the developments of the premature children when adjustments were made to correct for gestational age. However, children who suffered birth injury demonstrated a higher incidence rate of mental retardation than did the children who suffered no birth injury. The authors also found no relationship between birth weight and cognitive functioning.

Koenig (1950) investigated special educational placements and institutionalizations of 999 perterm infants born from 1902 to 1921. Premature infants, who weighed less than 2500 grams at birth, were matched with 1002 full-term

children who served as a control group. The premature children were divided into one group of single-born children and a second group who were the products of multiple births (referred to as "plural"-born children). The plural-born children were found to have a higher percentage (5.8%) of placements in special education classes than either the single-born or control groups. However, the single-born premature children were found to have a higher percentage (4.8%) of the placements in institutional settings such as "mental hospitals" and institutions for the crippled or blind. In both types of placements, the full-term children had a lower rate of placement than did the single- or plural-born premature children. Of the full-term children, only 1.7% were placed in special education classes, and only 1.2% were found in institutional settings. Thus, Koening concluded that prematuare children were at greater risk for long-term unfavorable consequences than were full-term children.

The studies conducted during 1800 to 1940 produced conflicting results in terms of long-term outcomes for premature infants. The mortality rates for these children were quite high, and few studies were comprised of infants weighing less than 1200 grams because few children below this birth weight survived. The criterion for inclusion also was typically based on the mother's report that the gestational period was less than 9 months. Because many of

the children were weighed on inaccurate or uncalibrated scales, there was usually question about the reliability of the child's weight at birth. In addition, several studies were conducted during wartime in Europe or were conducted during the depression years when there was a high incidence of influenza, ricketts, and malnutrition (Alm, 1953).

Also during this time, researchers tended to collect data through the use of questionnaires and subjective opinions. As Benton (1940) noted, the children were assessed by purely "impressionistic" measures, which made the utility of the research questionable. Even in the more controlled research of Rosanoff and Inmann-Kane (1934) and Koenig (1950) there was lack of demographic data and poor definition of terms. Finally, the results were reported in terms of percentages, without reference to statistical significance.

Despite the limitations of the research, however, certain trends were noted. The physical and mental growths of prematurely born children were delayed during the first 2 to 3 years of life. The degrees of delay appeared to be related to birth weight, i.e., the lower birth-weight children were more frequently delayed than the heavier birth-weight infants. Children with lower birth weights also were more frequently the products of multiple births. A higher incidence of birth injury, cerebral palsy, epilepsy, and mental retardation was noted in association

with low birth weight. Emotional disturbances such as high anxiety, restlessness, aggressiveness, and decreased attention span were also reported to be more common in prematurely born children. School failures, placements in special education classes, and institutional placement were often reported for premature children. It was often found, however, that the majority of low birth-weight children were functioning within normal limits by school age.

The disparate findings of the research conducted during this time led others to continue to investigate eventual outcomes for high-risk infants.

1940 to 1950

The medical management of high-risk infants during the 1900s through the 1930s was no different from that received by normal, healthy infants. There was also no regionalized perinatal care for high-risk infants nor was there specialized neonatal care. Estimates of frequency of high-risk or premature births varied greatly. For example, Benton (1940) reported that estimates of incidence rates for prematurity ranged from 2.5% to 11.6%. Mortality rates also were confounded by the inclusion of still-born infants in some estimates and their exclusion in others. Accordingly, the survival rates reported were influenced by mortality rates.

By the mid-1940s, fluctuations in estimates for mortality rates began to stabilize. More children were born

in hospitals, making the reports of birth statistics more accurate and uniform. In reporting the survival rates for infants born during 1945, Drillien (1958a) noted that 4.5% of the children who weighed less than 3 pounds survived beyond 1 year of life. At the same time, the survival rate for children weighing 3 to 3-1/2 pounds was 35%, with the highest survival rate, 91.6%, reported for those children who weighed between 5 and 5-1/2 pounds (Drillien, 1958a). These survival rates were based on the number of live births which occurred in Edinburgh, Scotland, in 1945. Hess (1953), reporting on the mortality rate for premature infants born during 1922 to 1950, found that 17% of the infants weighing between 605 and 1260 grams (1 pound, 5.5 ounces to 2 pounds, 12.6 ounces) survived beyond the first year of life. Hess (1953) further reported that 15% of the children were severely handicapped, with 41% of prematurely born children experiencing some form of cognitive or physical handicapping condition.

The first major study of prematurity and developmental outcomes conducted after World War II was published by Barlow (1945). His sample consisted of 514 preterm children and 501 full-term children who were seen medically in outpatient or private clinics. Barlow found mental abnormalities in 33.6% of the preterm group as compared to 11.2% of the children born at term. He concluded that intellectual functioning was correlated with birth weight.

In a retrospective investigation conducted by Eames (1945, 1959), 100 children who had experienced reading failure were selected for study; all had been referred for remedial reading intervention. The children were similar on measures of intellectual functioning and chronologic age. Eames found that 15% of the children were prematurely born or had experienced birth difficulties. Eames concluded that because there was an overrepresentation of prematurely born children in his sample, premature children were at higher risk for reading failure than were full-term children.

Kawi and Pasamanick (1959) found similar results in another retrospective analysis of factors related to reading disorders. Two hundred white males who were identified as poor readers were selected for the study. They found that low birth weight and birth and pregnancy complications were positively associated with impaired reading ability.

A follow-up investigation of 309 matched pairs of children was conducted by Douglas (1956) and Douglas and Gear (1976). The children, born in March, 1946, were matched on the factors of race, sex, ordinal position, maternal age, and the degree of crowding in the home at the time of the subject's birth. The children differed in birth weight, with half of the subjects weighing less than 2500 grams and half weighing more than 2501 grams. Douglas excluded those children who were known to be severely handicapped. Although scores on intellectual measures were

similar for both groups (mean IQ for the controls was 97 and 93 for the low-birth-weight children), the low-birth-weight children had lower school achievement scores. Reading difficulties, higher retention rates, and a greater number of adverse comments by teachers in reference to attitude towards work, ability to concentrate, and need to discipline were more frequent for the low-birth-weight children. No differences between the two groups were reported on the number of days of absence from school. Douglas also found no correlation between degree of prematurity and academic achievement.

Lubchenco, Horner, Reed, Hix, Metcalf, Cohig, Elliot, and Bourg (1963) investigated the scholastic progress of 63 children born between 1947 and 1950 who weighed less than 1500 grams at birth. Thirty-two percent had no handicapping condition, but 68% were reported to have central nervous dysfunction or a visual handicap. Forty percent of the subjects were found to be in the mentally retarded or borderline range of intellectual functioning. Of the remaining 60% of the children who were functioning in the normal range of intelligence, half (30%) had experienced school failure.

In a follow-up study of 273 children who weighed between 1000 and 2500 grams at birth, Beskow (1949) investigated their cognitive abilities and academic performances. He found that 4.6% of the children had intellectual

quotients of less than 60. Of the children who were enrolled in school, 25% experienced school difficulties such as an inability to keep up in class, difficulty in following instructions, reading failures, and pronounced nervous disorders.

In a similar investigation, Blegen (1952) found that of 524 preterm children born during the late 1940s, 4.6% had intellectual quotients that were 70 or less. Although there was no marked difference in the retention rates of preterm children as compared to the general population, 7.5% were placed in special schools for the handicapped. The premature children who were placed in traditional classrooms also experienced more academic difficulties than did their full-term counterparts.

Of three studies conducted during this period, the researchers found no differences between preterm children and those born at term. For example, Davis (1951) compared 50 preterm children with 50 full-term children at school age. The groups were matched for age, sex, nationality, and socioeconomic status. All of the subjects attended public school programs and were free from known physical or sensory handicaps. They were evaluated with a variety of intellectual, personality, and speech measures. In addition, school achievement was measured by teachers' grades. Davis found no differences between the groups in development of language or motor skills or academic achievement.

Howard, Worrell, and Colier (1952) followed the "personality development" of 22 preterm children born between 1930 and 1942 and who weighed 1820 grams or less at birth. At school age, they found that the children's intellectual functioning approximated a normal distribution; however, more children had intellectual quotients below 81 than would be expected in a normal population. Based on parent and teacher reports, the authors reported that over half of the children were emotionally maladjusted. They concluded that school entry should be delayed for 1 year for prematurely born children.

Two hundred fourteen children born between October, 1948, and October, 1951, were studied by Robinson and Robinson (1965). The children were divided into two groups: one consisting of children who weighed less than 2500 grams at birth and another consisting of children who weighed more than 2500 grams at birth. Children with known handicapping conditions were excluded from the study. Both groups were evaluated with the Stanford-Binet Intelligence Scale, the Goodenough-Harris Draw-A-Man Test, the reading subsection of the Wide Range Achievement Test, and a behavioral rating scale. No statistical differences were found between the two groups when those with known disabilities were excluded.

The studies conducted through the 1940s tended to lack control or comparative groups (Beskow, 1949; Howard et al., 1952; Lubchenco et al., 1963). The results of the

investigations conducted on children born 1940 to 1950 also were typically reported in terms of percentages, with no statistical analyses to test for significances of the results (Beskow, 1949; Blegen, 1952; Douglas, 1956; Douglas & Gear, 1976; Howard et al., 1952). The number of potentially available subjects also was limited by poor survival rates for low-birth-weight infants (Douglas, 1956; Douglas & Gear, 1976; Hess, 1953; Howard et al., 1952). Robinson and Robinson (1965), Douglas (1956) and Douglas and Gear (1976) also excluded children with known handicaps, which led to the exclusion of nearly one-third of the potentially available subjects. Three of the studies involving reading failure were retrospective analyses of children who had been referred for reading failure (Eames, 1945, 1959; Kawi & Pasamanick, 1959).

The investigations conducted during this period led physicians to the optimistic conclusion that for the majority of the high-risk infants, the long-term prognosis was favorable. However, at the same time, premature centers were being developed in the United States (Lubchenco, 1983). Encouraged by the results of the research conducted on the long-term effects of prematurity, physicians and investigators felt confident that with improved medical care for high-risk infants both mortality and morbidity rates would decline (Hess, 1953; Lubchenco, 1983).

1950 to 1960

> This era in premature infant care was best described as the "hands off" period. There were Gordon Armstrong incubators and few isolettes. The infants were under the watchful eyes of the nursing and medical staffs, who were concerned with cyanosis and apnea and the need for stimulation. Warmth and oxygen were provided and gavage feeding was well established, though feedings were delayed. There were few IV's given. Chemistry and hemotology laboratories, as well as x-ray examination were available, but not geared for these infants. Attending physicians and nurses depended upon clinical findings and a modicum of intuition to guide them in management. And parents were estranged from their infants. (Lubchenco, 1983, pp. 127-128)

During the 1950s, mortality rates began to improve over those reported in the 1940s. For example, Drillien (1958a) reported a 23.7% increase in the survival rates of infants weighing less than 3 pounds from 1945 to 1954. A 38% increase in the survival rate of infants weighing 3 to 3-1/2 pounds was also reported, and a decrease of 12.6% in the mortality rates for infants weighing between 3-1/2 and 4 pounds was noted (Drillien, 1958a).

However, while mortality rates decreased, a dramatic rise in morbidity rates was uncovered. Dann, Levine, and New (1958, 1964) reported that, based on a group of 100 children whose birth weights were less than 1001 grams, 59% of the children had significant visual handicaps and that their intellectual functioning was significantly lower than their full-term siblings. Drillien (1961b) also found a significant increase in severe handicapping conditions in

children born in 1953-1954 in comparison to those born during 1948-1950. She hypothesized that the increase in morbidity was a reflection of increase in survival rates of low-birth-weight infants. She urged researchers to follow these high-risk infants to better predict the long-term consequences of increased survival. The economic, societal, and ethical impacts of saving individuals in the high-risk group was at the core of the research efforts (Drillien, 1961a).

One or more physical defects per child were found in 53% of the children followed by Drillien (1961b). Visual defects accounted for 37% of the physical defects while 12% were reported to suffer from significant hearing loss. Four percent of the children were also diagnosed as having cerebral palsy. Half of the group was placed in full-time special education classes, and an additional 25% received part-time special education services. Seventy-eight percent of the children were classified by their parents or teachers as having behavioral problems such as immaturity, shyness, inattentiveness, and aggressivenes. One quarter of the children were found to be performing at low average or above in the public school programs.

Results of a comparative study of 200 children weighing less than 1501 grams at birth and 200 full-term children, all born in 1954, were reported by Corrigan, Berger, Dienstbier, and Strok (1967). Although two-thirds of the

control group children were performing at average or above-average grade level, three-fifths of the low-birth-weight children were functioning at average or above average grade level. The rate of special education placement for the control group was .5%, and a special education placement rate of 5% was reported for the low-birth-weight group.

Harper, Fischer, and Rider (1959) related birth weight to later handicapping conditions. The authors found that 48.1% of the children they studied whose birth weights were less than 1501 grams had significant intellectual deficits at ages 3 to 5 years. The rate for handicapping conditions dropped to 27.6% for individuals whose birth weights were 1501 to 2000 grams and to 18.2% for those weighing between 2001 and 2500 grams at birth. These rates also were compared to the rate of handicapping conditions in a full-term control group. Thirteen percent of the full-term controls were found to have significant intellectual handicaps. Although significant differences were found in intellectual functioning at all birth weights, children whose birth weights were between 2001 and 2500 grams were more similar in intellectual functioning to the control group than were those whose birth weights were less than 1501 grams.

In a follow-up study of 65 children weighing less than 1501 grams at birth (and who were matched with a full-term control group), Wright, Blough, Chamberlin, Ernest,

Halstead, Meier, Moore, Nauton, and Newell (1972) investigated cognitive functioning and school performance. These children, who were born between 1952 and 1956, were elementary school age at the time of the study. School performance was based on parent report and school grades. The Weschler Intelligence Scale for Children (WISC) was administered as a measure of intellectual functioning. Seventeen percent of the premature children did not attend a traditional school in comparison to 0% of the control group. Although half of the control group were succeeding at average or above-average grade level, only one-fourth of the premature children were performing at grade level or above. The prematurely born children also exceeded the controls in mortality rate, incidences of mental retardation and non-traditional school placement, poor school performance, and rate of significant visual defects.

Bacola, Behrle, DeSchweinitz, Miller, and Mira (1966a) found that the mean IQ for 40 children born in 1954 who weighed less than 1501 grams at birth was 80.1 for males and 99.7 for females. Half of the children had Stanford-Binet IQs in the "mentally retarded" or "borderline ranges." Two of the children had cerebral palsy, three had strabismus, and one child had a moderate hearing loss. In a parallel investigation of 48 children whose birth weights ranged from 1500 to 2500 grams, Bacola et al. (1966b) found that one-third of the children had Stanford-Binet IQ scores in the

mentally retarded or borderline ranges. The authors found that small-for-gestational-age infants had an increased probability of having a handicapping condition and that those children with lower birth weights had a higher probability of having subnormal cognitive functioning.

To compare 53 full-term children with 53 premature children born 1955 to 1956 at the end of kindergarten and at the end of first and second grade, DeHirsch, Jansky, and Langford (1966) tested the children on 37 different measures. At the end of kindergarten, the preterm children performed poorer than did the control group on measures of oral langauge and reading readiness skills. By the end of first grade, the preterm children also were significantly lower than the full-term controls on measures of reading and writing skills. At the end of second grade, the premature children were functioning at lower levels on all measures of academic performance when compared to full-term controls. The preterm children performed at a poorer academic level than the control group, even when the authors statistically controlled for intellectual functioning. The authors found that the premature females in their study had significantly less difficulty on measures of reading, writing, and spelling than did preterm males.

Frisk, Takkunen, and Holmstrom (1963) and Takkunen, Frisk, and Holmstrom (1963) found an increased rate of mental retardation in comparison to the general population,

through the study of school placement and intellectual functioning of 42 children born in 1955 who weighed less than 1700 grams at birth. They reported that 7% of the premature children were retained at the same grade placement in school. A special education placement rate of 10.3% was reported for the low-birth-weight children in comparison to a 3% special education placement rate for the general school population. Takkunen et al. (1963) found that while the overall health of the preterm children was good, there was increased rate of significant visual and neurological defects in that group. Frisk et al. (1963) also reported higher incidence of emotional disturbance in the prematurely born children.

Drillien (1967) studied 50 children born between 1955 and 1960 who weighed less than 1361 grams at birth. All of the children were tested with the Stanford-Binet Intelligence Test at age 5. None of the children were found to have an IQ above 90. Fifty-nine percent of the children were reported to be functioning in the borderline or mentally retarded ranges, with 30% of the children requiring full-time special educational placement because of mental retardation. Ten percent of the children received full-time special educational placement because of physical impairments. Although no physical defects or intellectual handicaps were found in 42% of the preterm children studied, behavior problems, such as restlessness and poor

concentration, were reported for 58%. There were a greater number of female subjects in the study, but they had fewer severe and moderate handicaps than did the males.

In a series of studies following a group of preterm children and a set of matched controls who were born 1950 to 1960, Weiner, Rider, Oppel, Fischer, and Harper (1965) and Weiner, Rider, Oppel, and Harper (1968) evaluated the children on measures of intellectual functioning, gross motor development, perceptual-motor skills, and academic performance. The authors matched the groups on variables such as race, sex, social class, maternal attitudes, and child rearing practices. Data were analyzed only for those children whose IQ scores were at least 60 and who were free from known gross motor handicaps, sensory deficits, and who suffered from no severe emotional disturbances. The low-birth-weight children had significant impairments on measures of perceptual-motor skills, abstract reasoning, comprehension, articulation disorders, and intellectual performance. Weiner et al. (1968) found that when the extreme of the distribution was examined (i.e., WISC IQ = 50 to 79), approximately twice as large a proportion of low-birth-weight children as compared to the controls fell in that range. The authors concluded that birth weight was significantly related to reading and mathematics skills as well as to grade placement. The children with lower birth weights also were found to have lower mathematics and

reading scores than the full-term controls. No statistical interactions were found among race, sex, social class, or quality of mothering.

The research efforts conducted on children born in the 1950s reflected a lower incidence rate of mortality but an increased rate in morbidity. Weiner (1962) criticized the studies of this time for failure to use factorial designs and for absence of theoretical bases. The results of the majority of the studies were reported as percentages, with no further statistical analyses of the data (Bacola et al., 1966a; Corrigan et al., 1967; Drillien, 1961a, b, 1967; Frisk et al., 1963; Harper et al., 1959; Takkunen et al., 1963; Wright et al., 1972). Other problems were related to measurement techniques. Weiner et al. (1965) used subjective measures to assess the subjects' speech maturity, thinking mode, and ability to follow directions. Parent or teacher reports were used to determine behavioral disturbances by Drillien (1967) and Frisk et al. (1963). Teacher report or school grades were the only measures used by Corrigan et al. (1966) and Wright et al. (1972) to assess academic performance. Despite the limitations of the research efforts, however, the trend toward unfavorable long-term consequences for the prematurely born was documented.

During this time, the associations between oxygen administration and retrolental fibroplasia, chloramphenicol

and the Gray Baby Syndrome and sulfanamides, Vitamin K and kernicterus were uncovered (Lubchenco, 1983). Therefore, a number of questions were raised about postnatal management as related to long-term outcomes. Some evidence suggested that metabolic interventions could improve outcome. It was hypothesized that with vigorous metabolic intervention, outcomes for high-risk infants could be greatly improved (Lubchenco, 1983).

1960 to 1970

The first newborn center in the United States was established at Grace New Haven Hospital, New Haven, Connecticut, in 1960 (Butterfield, 1983). The center, which developed a transport system and outreach educational program, was committed to develop programs and policies designed to improve the outcome of pregnancy (Butterfield, 1983).

In comparison to the 1950s, Lubchenco (1983) stated that the medical treatment of premature infants had become more aggressive. Such metabolic imbalances as acidosis and hypoglycemia were being treated (Lubchenco, 1983). While electronic heart rate monitoring had been available in the 1950s, it did not enter into routine clinical practice for premature and high-risk infants until the 1960s (Vidyasagar, 1983). An instrument designed for the continuous monitoring of respiratory rate was introduced in 1961. However,

Vidyasagar (1983) noted that "because of the high cost of equipment not all infants had both heart rate and respiratory rate monitoring" (p. 51).

Lubchenco (1983) also cited the initial use of continuous positive airway and respirators during the late 1960s. In addition, the radiant warmer was introduced into neonatal care to assist in thermal regulation (Lubchenco, 1983). "The hypothesis was proclaimed throughout perinatal circles that the efforts needed to improve survival of the very low-birth-weight infant enhanced the chances of improved, long-term outcome" (Lubchenco, 1983, p. 131). Decreases in mortality and morbidity were, therefore, reported by nearly all of the perinatal centers (Lubchenco, 1983).

Fitzhardinge and Ramsey (1973), who studied 32 chidren born betwen 1960 and 1966 who weighed less than 1251 grams at birth, noted that the children's difficulties in later life may have been the result of the interaction between prematurity and neonatal management. The authors followed the survivors from birth until entry into school. School failure or part-time special educational placement was reported for 40% of the males and for 25% of the females. Although none of the females were placed in full-time special educational schools, 13% of the males were reported to have been placed there. Thus, three-fourths of the females and less than half of the males were making satisfactory progress in school.

In a similar study, Fitzhardinge (1976) reported the results of an investigation of low-birth-weight infants whose intellectual quotients fell within the average range. Deficits were noted in the areas of abstract verbal reasoning and perceptual motor integration skills. A higher rate of poor school performance as well as an increased rate of placement in learning disabilities classes (15%) were noted for this group. The academic difficulties reported occurred at a higher rate than would normally be expected in the general population. Despite intellectual functioning within the average range of cognitive abilities, the low-birth-weight children remained at risk for significant academic deficits.

Rubin, Rosenblatt, and Balow (1973) investigated the academic progress of 219 children who were born from 1960 to 1964. The children were divided into four groups on the basis of gestational age and birth weight. A questionnaire was sent to the teachers of the children selected for the study. Information regarding retention, special educational placement, and receipt of services such as remedial reading programs or speech therapy intervention was requested. Associations between low birth weight (less than 2501 grams at birth) and higher rates of retention, increased rates of placement in special classes, and an increase in receipt of special services were found. Although there were no gender differences on objective measures of performance,

low-birth-weight males were reported to have higher incidence of school-identified behavioral problems than did females of the same birth weight. The authors concluded that low-birth-weight, preterm males and small-for-gestational-age subjects of both sexes constituted a high-risk population. Two-thirds of the low-birth-weight males and more than one-half of the small-for-gestational-age subjects exhibited academic difficulties which resulted in special educational placements or special services in the early elementary grades.

A group of 93 children who were born between March, 1965, and August, 1972, with birth weights ranging from 960 to 4360 grams, were investigated by Gunn, Lepore, and Outerbridge (1983). The majority of the 61 children who were enrolled in school were reported to be functioning at an average or above-average level. Three percent of the children attended special school programs, and 10% of the children were retained. Behavioral problems were noted for a majority of the children, as was increased rate of respiratory illnesses such as asthma and pneumonia. The authors found that those children weighing less than 1501 grams at birth were at higher risk for subsequent academic, behavioral, and health difficulties.

Taub, Goldstein, and Caputo (1977) reported the results of a longitudinal follow-up study of 38 preterm children in comparison to 26 full-term children (who served as the

control group). Although the Full Scale intellectual quotients (IQs) on the Weschler Intelligence Scale for Children (WISC) showed no difference between the groups, the Performance IQ scores significantly favored the full-term group. School achievement was assessed by computing the mean report card grades for the subjects. No differences were found between the two groups in social or academic functioning, as reflected in the subjects' report cards. However, the authors noted that data were missing for a large number of subjects. On the basis of the WISC Performance IQ, the authors concluded that "the results indicated that even relatively intact, middle-class premature infants are at risk for specific deficits in later cognitive functioning" (p. 236).

Incidence rates of severe handicapping conditions among low-birth-weight children born during this time frame have been reported by a number of authors (Dinwiddie, Mellor, Donaldson, Tunstall, & Russell, 1974; Johnson, Malachowski, Grobstein, Welsh, Daily, & Sunshine, 1974; Jones, Cummins, & Davies, 1979; Outerbridge, Ramsay, & Stern, 1974; Stewart & Reynolds, 1974; Stewart, Turcan, Rawlings, & Reynolds, 1977). The conditions were severe enough to warrant placement in special educational classes or placement in full-time special schools. Outerbridge et al. (1974) reported a 14% rate of severe handicapping conditions in their premature subjects. They also reported that recurrent

respiratory illness was found in a significant number of the children.

In another series of investigations of long-term outcomes for premature infants, Stewart et al. (1974, 1977) reported incidence rates of significantly handicapping conditions that varied from 7.0% to 9.5% of the subjects. Stewart, Turcan, Rawlings, Hart, & Gregory (1978) reported that 6% of their subjects were attending special schools while 18% had a handicapping condition which required special educational services within a traditional school setting.

Dinwiddie et al. (1974) investigated outcomes for children who had received mechanical ventilation at birth. Of the 50 children who survived to school age, 14% were found to have serious mental or physical handicaps. An overall handicapping rate of 10.9% was also reported by Jones et al. (1979) for low-birth-weight children. They reported that 5.3% of the subjects were found to have handicapping conditions severe enough to warrant placement in full-time special educational facilities. Johnson et al. (1974) reported that 19% of their subjects who had been treated with mechanical ventilation during the newborn period had moderate to severe handicapping conditions that prevented placement in a traditional school setting.

Reading proficiency in 1960s born high-risk infants has been a topic of investigation for several authors (e.g.,

Balow, Anderson, Reynolds, & Rubin, 1969; Doehring, 1968; Frances-Williams & Davies, 1973; Galante, Flye, & Stephens, 1972; Kitchen, Rickards, Ryan, McDougall, Brillson, Keir, & Naylor, 1979; Menkes, Welcher, Levi, Dallas, & Gretsky, 1972). A retrospective analysis of birth histories of a group of children who were functioning at least 2 years below grade level was conducted by Doehring (1968). The birth histories of the group of poor readers was compared to those of a randomly selected group of "good" readers (i.e., reading abilities at grade level or above). A significantly greater number of poor readers were found to have been the products of premature gestation or difficult delivery. He concluded that compromises in the neonatal period placed children at greater risk for later reading deficits.

In an investigation of the relationship between birth weight and length of gestation to later cognitive and academic functioning, Balow et al. (1969) found significant differences between full-term and premature children at school age. The children who were born at term had significantly higher performance on the Metropolitan Readiness Test at age 5 and on the Wide Range Achievement Test at age 7 than did those who were premature at birth. While the authors found birth weight to be a significant factor, neither gestational age nor sex differences were found to correlate significantly with cognitive or academic functioning.

Menkes et al. (1972) reported that in a group of low-birth-weight children, reading scores on the Wide Range Achievement Test increased as birth weight increased. However, statistical comparison of the groups was not possible because too few subjects were represented in each of the birth-weight categories.

A longitudinal study of 71 1960s born children was conducted by Galante et al. (1972) to determine factors of early development correlated with school achievement. They reported that 40.9% of the poorest readers had histories of birth complications, such as precipitous delivery or prematurity, in contrast to only 14.3% of the average or above-average readers.

Stahlman, Hedval, Dolanski, Faxelius, Burko, and Kirk (1973) reported that 66% of the children in their investigation who weighed less than 2000 grams were found to have intellectual quotients of 80 or below, academic deficits, or behavior problems. The results were compared to the findings for a group of full-term children who served as a control group. Thirty-eight percent of the control group were found to have similar deficits in cognitive, behavioral, or academic functioning. They predicted that as major disabilities in premature infants decrease, increases are found in mild cognitive deficits, academic failures, and retention rates.

Frances-Williams and Davies (1974) investigated the reading levels of 49 children ages 7 to 12 years who weighed less than 1501 grams at birth. While the mean WISC Full Scale intellectual quotient was in the average range of cognitive functioning, 18.6% of the children had made no progress in reading. An additional 10.2% of the low-birth-weight children were 3 to 5 years behind in reading ability. In a similar study conducted by Davies and Stewart (1975), the authors also reported that a significant number of the children who weighed less than 1501 grams at birth and who had intellectual quotients in the average range had learning problems. Deficits in the area of abstract verbal reasoning and perceptual motor integration also were frequently observed. Those children who were small-for-gestational-age infants were more at risk for learning problems than their same birth weight but appropriate-for-gestational-age counterparts.

Kitchen et al. (1979) conducted a longitudinal investigation of the long-term outcomes for 143 8-year-old children born February 1966 through March 1970 and who weighed between 1000 and 1500 grams at birth. Placement in special educational facilities was found for 4.4% of the subjects. An additional 10.1% of the children required special educational services. Of the children who were placed in traditional classrooms, 37.3% experienced academic deficits. No significant academic deficits were reported for the

remaining 41.8% of the children. The authors concluded that while there was a decrease in the more severely handicapping conditions from those reported in the 1950s research, low-birth-weight children still remained at greater risk than the general population for deficits in academic success.

In another investigation of low-birth-weight children at school age, Steiner, Sanders, Phillips, and Maddock (1980) found that less than half of the subjects survived to school age. All of the children in their study were born from 1963 to 1971. Of the survivors, 7.5% were nonreaders, 26.1% were 3 or more years behind in reading, and 49.2% were 2 to 3 years below expected grade level. Significant behavioral problems also were reported for 63.8% of the subjects. Although approximately one-third of the subjects were found to have no significant intellectual, behavioral, or academic deficit, the majority of the subjects suffered from reading and/or behavioral difficulties.

Decreases in incidence rates of mortality and morbidity for high-risk infants born during the 1960s have been reported. Although the investigations were based on small samples (e.g., Davies & Stewart, 1975; Dinwiddie et al., 1974; Fitzhardinge & Ramsay, 1973; Francis-Williams & Davies, 1974; Johnson et al., 1974; Menkes et al., 1972; Stewart et al., 1977; Stewart et al., 1978) and the studies suffered from large numbers of subjects who were lost before follow-up or deceased (Dinwiddie et al., 1974; Gunn et al.,

1983; Jones et al., 1979; Taub et al., 1977), results indicated that the majority of the survivors had significantly less probability of a severely handicapping condition than did those in the studies of their predecessors. Further, although academic deficits were reported, comparisons to control groups were absent (e.g., Fitzhardinge & Ramsay, 1973; Gunn et al., 1983; Johnson et al., 1974; Jones et al., 1979; Kitchen et al., 1979; Outerbridge et al., 1974; Stewart et al., 1978; Stewart & Reynolds, 1974; Steiner et al., 1980). Two studies (Doehring, 1968; Galante et al., 1972) used a retrospective format to establish correlations between neonatal compromise and later reading achievements. Subjective criteria, in the form of parent reports (Doehring, 1968), teacher completed questionnaires (Gunn et al., 1983; Steiner et al., 1980), and school report cards collected from a variety of teachers in public and private schools (Taub et al., 1977) were the only measures employed to assess academic or behavioral functioning. Three studies (Johnson et al., 1974; Outerbridge et al., 1974; Stewart et al., 1977) used subjects whose ages ranged from early childhood to school age to analyze long-term consequences of prematurity. Thus, it was difficult to determine the long-range consequences of prematurity in terms of milder forms of educational deficits and impacts of increasing numbers of high-risk survivors on societal, educational, and health-care resources.

1970s to Present

The trend towards aggressive treatment for the sick neonate progressed during this time. As Vidyasagar (1983) noted, "the emphasis has been placed on expanding neonatal monitoring to include physiologic parameters and on making the monitoring noninvasive and simpler to deal with" (p. 52). Noninvasive blood gas and biochemical monitoring, intracranial pressure, and cerebral blood flow monitoring are examples of techniques that were developed to improve neonatal intensive care management (Vidyasagar, 1983, p. 52).

Kitchen, Ryan, Rickards, Gaudry, Benton, Billson, Fortune, Keir, and Lundahl-Hegedus (1978) conducted a study comparing mortality rates for sick and premature infants who received care in neonatal intensive care units or traditional medical care facilities. Significantly lower rates of infant mortality were reported for the neonatal intensive care unit patients than in the traditional medical care setting infants.

In similar investigations, Klienman, Kovar, Feldman, and Young (1978) and Lee, Paneth, Gartaner, Pearlman, and Gruss (1980) found that the improvement in medical care and medical technology were the most probable cause for decreasing rates of infant mortality. When obstetricians and neonatologists combined efforts to prevent intrapartum and neonatal asphyxiation, Lubchenco (1983) reported that

the mortality rates (at Colorado Medical Center) were dramatically reduced.

In 1979, the number of neonatal intensive care units in the United States was estimated at 448, with a total of 10,040 available neonatal intensive care beds. This figure included 3,700 tertiary bed centers and 6,340 Level II beds (Vidyasagar, 1983, p. 56).

In Florida, Children's Medical Services (CMS) was established in 1973. One of the CMS goals was "to address the needs of high risk and critically ill newborns through the development of a statewide system of neonatal/perinatal intensive care" (Schiebler & Freedman, 1983, p. 704). Resnick, Bauer, Cupoli, Ausbon, Evan, and Regionalized Perinatal Staff (1983) reported that as mortality rates declined, morbidity rates decreased. "Low birth weight infants, less than 1500 gm at birth, have had a three-fold reduction in the incidence of developmental delay in less than a decade (50% prior to 1973, 15.4% current study)" (Resnick et al., 1983, p. 838). Developmental delay was defined as a developmental score which was less than 70 on a standardized measure.

Drillien, Thompson, and Burgoyne (1980) were in disagreement with the lowered estimates of incidence rate of handicapping conditions. The authors stated that the incidence of major handicap, as compared with low-birth-weight infants born during 1953 and 1955, showed little

change when earlier born infants who had been subjected to severe restriction of fluids and caloric intake were excluded from the analysis (Drillien et al., 1980). Fitzhardinge, Kalman, Ashby, and Pape (1978) also calculated incidence rates of handicapping conditions based on number of live births for infants weighing less than 1501 grams and who were born during 1961 and 1965 in comparison to those of the same birth weight born between 1970 and 1975. They found that although the proportion of normal survivors increased as a result of decreased mortality, the incidence rate of severely handicapping conditions remained at 6% (Fitzhardinge et al., 1978). Similar results were reported by Stewart, Reynolds, and Lipscomb (1981) in a comprehensive survey of literature relevant to outcomes for very low-birth-weight children. They found that the incidence rate for handicapping conditions for infants weighing less than 1501 grams at birth remained at 6% from 1946 to the present (Stewart et al., 1981).

In discussing the incidence of cerebral palsy, Paneth, Kiely, Stien, and Susser (1981) noted a decrease (by 24%) in infant mortality for infants weighing less than 1500 grams at birth, while an increase in the incidence rate for cerebral palsy in this population has been reported. They stated that during the 1950s the cerebral palsy rate was 7.7%, but it decreased to 2.3% in the 1960s; in the 1970s it rose to 4.6% again. They noted that the increase in the

1970s was significantly lower than the prevalence of cerebral palsy in the 1950s but that the rate doubled from the 1960s to the 1970s. The authors hypothesized that the recent increase may have been attributable to the increased survival rates for sicker, lower birth-weight infants.

In discussing scholastic outcomes for 164 children who weighed between 800 and 1500 grams at birth, Kitchen, Rickards, Ryan, McDougall, Billson, Kier, and Naylor (1979) found that 5.1% were attending special educational facilities. Nearly 16% of the children had made no beginning in reading or were 18 months or more behind in reading. When the low-birth-weight children were compared to a group of full-term children (who served as a control group), only 45% of the preterm children had minimal or no handicapping conditions in comparison to 72% of the full-term children.

Gunn, Lepore, and Outerbridge (1983) reported on the school performance of 87 children who weighed between 960 and 4360 grams at birth and who were mechanically ventilated during the newborn period. Seven percent of the children were found to have a significant handicapping condition; however, only 3% required full-time special educational services. Of those attending traditional school programs, 9% had repeated a grade in school and 47% were performing poorly in school (as reported by their teachers). Health problems reported included lower respiratory tract

infections and asthma. The most significant factors related to long-term outcomes for the subjects were birth weight of less than 1500 grams, neurologic sequelae, and socioeconomic factors.

Drillien et al. (1980) investigated the long-term outcomes for children who weighed less than 2000 grams at birth and reported that 8% required special educational placement. They noted that "those who showed no evidence of early intrauterine insult and who were neurologically normal in the first year of life were largely indistinguishable from control children reared in similar homes" (Drillien et al., 1980, p. 44). Achievement in reading and spelling tended to favor the control group and the neurologically normal low-birth-weight group. Statistically significant relationships among problems in school and the factors of social class, postnatal complications, and the neurological and developmental status at 1 year were also found.

Hack, Fanaroff, and Merkatz (1979) found an increased incidence of learning, reading, and behavioral disorders in children who weighed less than 1500 grams at birth. A group of 291 children born during 1975 and 1976 were studied. The children were divided into two groups; one consisted of children weighing 500 to 1000 grams at birth and the other of children who weighed between 1001 and 1500 grams at birth. They found that the smaller infants had a mortality rate of 60% while the larger infants had only a 24% rate. Ten

percent of the remaining subjects were lost to follow-up analysis, and 18% were excluded from the academic analysis because they were considered to be impaired. Thus, 28% of the children weighing less than 1000 grams at birth and 54% of the children weighing over 1001 grams at birth were available for study. The authors found that the lowest birth-weight children were most at risk for milder forms of long-term adverse conditions of prematurity.

Hunt (1981) investigated the cognitive status of 72 children who weighed less than 1501 grams at birth. Twenty-eight percent of the children, who were 4 to 6 years old at the time of the investigation, were found to have significant cognitive deficits. Of the children whose intellectual functioning was in the average range and who were enrolled in a school program, 18% were found to be experiencing academic difficulties. Hunt also found that children who had hyaline membrane disease were at greater risk for intellectual deficits and academic failures than premature children who had not had the disease. The females in Hunt's investigation were found to have the same incidence rate for handicapping conditions as the males; however, the severity of the disabilities was less for females than for males. She concluded that "four out of ten children with birth-weights <1501 grams will experience developmental problems in childhood that will be of consequence and may require special educational efforts" (Hunt, 1981, p. 349).

Several authors have investigated the impact of ventilation, bronchopulmonary dysplasia, and prematurity on later health and developmental status (e.g., Fitzhardinge, Pape, Arstikaitis, Boyle, Ashby, Rowley, Netley, & Swyer, 1976; Northway, 1979; Pape, Bunic, Ashby, & Fitzhardinge, 1978; Vorh, Bell, & Oh, 1982). Fitzhardinge et al. (1976) followed the health status of 33 children who weighed less than 1501 grams at birth and who had been ventilated during the newborn period. They found that upper respiratory tract infections were more common in children who had bronchopulmonary dysplasia than in children whose birth weights were similar but who did not have the disease. Five percent of the children suffered from retrolental fibroplasisa, and 29% were found to have significant neurologic sequelae, such as cerebral palsy. The males in the investigation were more at risk for health, ocular, or neurologic compromise than were the females. Finally, those who weighed more than 1000 grams at birth had a greater incidence of cerebral palsy than those who weighed under 1000 grams.

In a similar investigation, Pape et al. (1978) studied outcomes for 42 infants who weighed less than 1001 grams at birth and who were diagnosed as having bronchopulmonary dysplasia. Thirty-five percent of the children suffered from recurrent lower respiratory tract infections, 16% suffered from rentrolental fibroplasia of Grade II or greater, and 9% were found to have major neurologic defects.

The authors concluded that defects of the central nervous system were closely associated with a neonatal history of intercranial hemorrhage and/or seizures.

Vohr, Bell, and Oh (1982) investigated relationships between bronchopulmonary dysplasia and later developmental outcomes. The authors divided the 59 children into three groups. All of the children weighed less than 1501 grams at birth, but they varied as to the number of days ventilated and severity of subsequent lung disease. Those children who were diagnosed as having bronchopulmonary dysplasia were found to experience significantly more frequent and more severe respiratory difficulties than children who were free from bronchopulmonary dysplasia. The bronchopulmonray dysplasia group also was found to have a 15% rate of cerebral palsy, a 15% rate of blindness due to rentrolental fibroplasia, and a 13% incidence of hydrocephalus. These rates were significantly higher than those found in the nonbronchopulmonary dysplasia groups. The authors concluded that infants who suffer from bronchopulmonary dysplasia were at higher risk for subsequent health and developmental delay than were children of similar birth weights but who did not suffer from the disease.

In discussing the etiology and outcomes of individuals who were diagnosed as having bronchopulmonary dysplasia, Northway (1979) found that 37% of the infants surviving with Stage IV bronchopulmonary dysplasia became clinically normal

by age 3. Twenty-nine percent were found to have minor handicapping conditions, which included height below the third percentile (relative to "normal"), weight below the third percentile, an intellectual quotient between 80 and 90, and mild respiratory symptoms. Significant handicapping conditions, such as mental retardation, blindness, deafness, and/or cerebral palsy, were also found in 34% of the survivors.

The studies conducted on children born during the 1970s reflected the continued decrease in infant mortality. However, disagreement among investigators continued in regard to the prevalence of handicapping conditions in the high-risk infant survivors. The disagreements centered on inclusion or exclusion of children on the basis of the type of treatment received or differing criteria employed for describing handicapping conditions. Although there was decreased emphasis on the long-term outcomes for high-risk infants at school age, the evidence reflected that while the more severe handicapping deficits decreased, academic deficits requiring intervention remained.

Summary of the Literature Pertaining to High-risk Infants

The literature supports the contention that long-term outcomes for high-risk infants are different than those for their full-term counterparts. Differences in intellectual functioning, school placement, reading ability, mathematics

performance, retention rates, and long-term health status have been reported. Most importantly, throughout the literature the differences have favored the individual born at term.

Certain handicapping conditions have been found to occur almost exclusively in premature or low-birth-weight infants. For example, as early as 1862, Little observed a relationship between low birth weight and Little's Disease (cerebral palsy), epilepsy, and mental deficiency. More recently, the handicapping conditions of retrolental fibroplasia, bronchopulmonary dysplasia, and certain types of intercranial hemorrhages have been found to occur most frequently in the high-risk infant population.

Investigations into the long-term impacts of serious illness during the neonatal period have tended to support the hypothesis that high-risk children remain at risk throughout early and middle childhood. At school age, these children have been found to experience difficulty in mastering reading and arithmetic skills, even when their intellectual functioning has been in the average range. Placement in special educational settings has also been at a higher rate for this group than for the general population. Some evidence reflects that these children remain at greater risk for subsequent illness in later life.

The studies reviewed, however, have suffered from a number of technique limitations which in turn have severely

restricted the applicability of the results. Failure to employ control or comparative groups has been found in several studies. Much of the research has also been conducted on samples too small to yield statistically significant results. Incomplete descriptions of samples also were found in several investigations. Finally, large numbers of subjects lost before follow-up was noted in several longitudinal studies.

It has been suggested that long-term outcomes for high-risk infants are related to type of medical management received during the newborn period. In several studies, subjects ranged from infants to middle-school age. No effort was made to control for initial treatment differences (which could have affected long-term outcome). Accordingly, the results of those investigations may have been confounded by inclusion of subjects who were different at the onset of the study.

Another difficulty in samples in earlier investigations of the long-term effects of prematurity is the influence of historical factors. Studies conducted in Europe prior to and shortly after World War I may have been influenced by economic conditions and available medical treatments. During post World War I research, massive outbreaks of influenza and ricketts also occurred. Economic instability, poor nutrition, and inadequate medical treatment thus may

have confounded results of investigations conducted in Europe at the close of World War I.

Criteria for determining gestational age also have varied over time. Individuals selected for inclusion in one study may not have been included in others. Variations also have been found in definitions for handicapping conditions; definition as a disability in one study may not have been a disability in another. This confusion has led to wide discrepancies in data concerning prevalancy rates for prematurity and for subsequent disability.

In collecting data on long-term outcomes for high-risk infants, researchers often have relied solely on subjective measures, such as parent and teacher reports. Other subjective measures included use of investigators' opinions about subjects' cognitive functioning or speech maturity and use of school report cards as criteria for scholastic functioning. Applicability of such data is limited because it is difficult to generalize the results.

Statistical inadequacies were noted in a number of studies reviewed. Data tended to be reported in terms of percentages with no reference to statistical significances. Also, control groups were frequently absent and comparative analyses were not conducted. Further, continuous variables, such as birth weight and gestational age, were often treated as categorical variables.

In considering future directions of the study of long-term outcomes for high-risk infants at school age, four factors should be considered. One is use of a large enough sample so that statistical analysis of the data is possible. Random selection of representative high-risk infants also should be used. Data should be collected from the use of objective measures, such as standardized achievement tests. Finally, data collected should be analyzed in reference to a comparison group. If these factors are addressed adequately, the results of investigations will have applicability to other high-risk groups.

Assessment Instruments

Introduction

This part of the review of the related literature focuses on the assessment instruments used to measure school achievement of kindergarten students in Alachua County public schools. In Alachua County public schools, the Metropolitan Readiness Test (MRT) was administered to kindergarten students.

Metropolitan Readiness Test

The MRT is purported to measure the ability to recall specific academic information in a direct manner (Gronlund, 1978). Although the test (which was first published in 1931) has undergone many revisions, the format remains

essentially unchanged (Gronlund, 1978). Five scores are derived based on auditory skills, visual skills, language skills, prereading skills, and quantitative concepts. The scores are given in stanines and raw scores (Balow, Farr, Thomas, & Prescott, 1978). The scores can be compared to national norms (Balow et al., 1978). The test can be administered by anyone who can read the directions as they are stated in the manual and who can use a stop watch (Balow et al., 1978). The readiness edition comes in three forms that can be administered in four to eight sessions in a total time of 120 minutes.

The content of the MRT was determined by the authors who analyzed textbook series and curriculum syllabuses, as well as gathering statements from curriculum experts serving on various state and national educational committees (Gronlund, 1978). The content was based not only on the current curriculum at the time of the survey but also on the authors' predictions of newer trends in the national curriculum (Haertel, 1985). The 1978 edition of the MRT was based on mid-1970s curriculum guidelines.

The most recent standardization of the MRT was done on students in both the fall and spring (Haertel, 1985). Although all of the batteries of the Metropolitan Achievement Tests (MAT) were administered, not all of the MAT editions were administered to students (Haertel, 1985). A total of 550,000 students in 225 schools in 49 states

volunteered to participate in the normative sample (Balow et al., 1978). Wolf (1978) noted that the authors attempted to statistically control for the effect of volunteerism in the sample. The sample was collected by individual schools. An alternate school (which was matched on relevant variables) was substituted for schools which were selected by the authors but which declined to participate (Wolf, 1978).

The internal consistency for the Metropolitan Achievement Tests ranges from .80 to .95 for each subtest; a median internal consistency of .90 was reported (Haertel, 1985). The standard error of measurement rarely exceeds four scaled score points or .5 on the grade equivalent scale (Swanson & Watson, 1982).

The content validity must be determined by each school district (Balow et al., 1978). As school districts may vary in curriculum procedures and objectives, the MRT is not a universally valid test of school achievement. Gronlund (1978) noted "the important question in selecting an achievement battery is, of course, the extent to which the tests measure a representative sample of the intended learning outcomes" (p. 65). The manual includes information regarding the determination of the content validity for the MRT in relation to the curriculum of a given school district.

In Alachua County, the Metropolitan Achievement Tests were selected through the recommendation of a committee to

the superintendent of the public school system (C. Hirsch, personal communication, March 11, 1986). The committee was comprised of teachers and administrators from various schools within the county who reviewed a number of tests before making a recommendation to the superintendent. The superintendent then made a recommendation to the Alachua County School Board for final approval for the use of the Metropolitan Achievement Tests within the school district (C. Hirsch, personal communication, March 11, 1986).

As with all assessment measures, the MRT has strengths and weaknesses. One of its strengths lies in its longevity and acceptability throughout the United States (Gronlund, 1978). The publishers have revised the MRT many times since its initial publication in 1931 (Gronlund, 1978). In addition, the MRT is easy to administer. The test booklet provides detailed information on the administration and interpretation of the test results (Wolf, 1978). The test, which is scored by hand, provides stanine scores that can be used to make national comparisons.

The technical data concerning the test construction, sampling procedures, reliability coefficients, and validity studies are not presented in the user's manual. Rather, they are published in a separate technical manual, which often makes it inaccessible to teachers or guidance personnel (Gronlund, 1978). Because not all of the editions of the Metropolitan Achievement Tests were administered to

the sample, questions arise as to the equivalency of the various editions of the Metropolitan series.

Another criticism noted by Wolf (1978) concerned sample bias. Because of sampling errors, an overrepresentation "of low income and low ability students were selected in the norming sample" (Wolf, 1978, p. 70). He concluded that the Metropolitan series may underestimate the school achievement of the average American student (Wolf, 1978). Further, Gronlund (1978) cautions that because the authors "projected" the curriculum trends, the Metropolitan series may not accurately reflect the actual curriculum of the schools.

Summary

The MRT was used in the public schools of Alachua County as a standardized measure of achievement. The MRT is a well respected achievement test with a long history of use in public school systems throughout the United States. The content of the Metropolitan series was selected by approved methods, and procedures for determining the validity of the tests are contained in the technical manual. The Metropolitan series was selected in Alachua County by a selection process which included recommendations from teachers, guidance personnel, administrators, the superintendent of the schools, and the school board. The internal consistency of the MRT is reported to be high, and the

standard error of measurement remains relatively low. The Metropolitan series have been standardized on a representative sample of students enrolled in public schools in the United States. The MRT also yields stanine scores which may be used to make comparisons to the national normative sample.

Analysis Procedures

Introduction

This part of the review of the related literature focuses on the analysis procedures to be used in the study. The data in this study were tested for significance by using multiple regression analyses and chi-square analyses. The analysis procedures are discussed here, and the strengths and weaknesses of multiple regression analysis and chi-square analysis procedures are outlined.

Multiple Regression Analysis

Kerlinger and Pedhauser (1973) stated the purpose of multiple regression analysis "is to help 'explain' the variance of a dependent variable . . . by estimating the contributions to this variance by two or more independent variables" (p. 4). Instead of viewing each variable singly with each dependent variable in an effort to explain complex events, multiple regression analysis considers the influence

of several variables in an analysis procedures. Kerlinger (1973) stated

> multiple regression analysis is an efficient and powerful hypothesis-testing and inference-making technique since it helps the scientist study, with relative precision, complex interrelations between independent and dependent variables, and thus helps him [her] "explain" the presumed phenomenon represented by the dependent variable. (p. 631)

In the multiple regression analysis there are strengths and weaknesses in the procedure. Kerlinger and Pedhauser (1973) state that "there are five or six weaknesses of multiple regression analysis which make its use difficult" (p. 441). They noted that there is a tendency for researchers to use too many variables in an indiscriminate manner (Kerlinger & Pedhauser, 1973). Research paradigms may be obscured by researchers who are completely dependent upon multiple regression equations and related statistics to make sense of their data (Kerlinger & Pedhauser, 1973). The problems can be circumvented by researchers selecting variables on the basis of theory and/or factor analysis (Kerlinger & Pedhauser, 1973). The analysis of the data also can be made clearer by the selection of fewer unrelated variables (Kerlinger & Pedhauser, 1973).

The unreliability of regression weights provides another source of weakness in the multiple regression analysis. When larger samples with fewer independent variables are studied, the standard error is reduced (Kerlinger & Pedhauser, 1973). Kerlinger and Pedhauser (1973)

indicated that sample sizes of more than 100, in conjunction with independent variables with low intercorrelations, sufficiently reduces the error rate.

Since there are no rules to dictate the order of entry of the independent variables in the regression equation, the squared semipartial correlations may vary according to the order of entry into the regression equation. This weakness can be controlled by entering the variables according to the dictates of the theory and the research problem (Kerlinger & Pedhauser, 1973). In regard to the changing nature of the squared semipartial correlation, there is no absolute method to determine the importance of the relationship of the independent variable to the variance of the dependent variable. Kerlinger and Pedhauser (1973) concluded that

> much, perhaps most, research in the behavioral sciences has to be ex post facto in nature . . . and the independent and dependent variables consequently have a messiness about them that controlled experimentation does not have, but these are the complications of the real world. (pp. 443-444)

The strengths of the multiple regression analysis lie in its description of the relationship among natural phenomena. The nature of the multiple regression equations reflect the close relationship between the method and scientific inquiry. Any number of variables can be analyzed in the equation. It is an especially powerful analysis of nonexperimental data. Kerlinger and Pedhauser (1973) stated

> a final strength of multiple regression is its rich yield of various statistics to be used in the

> interpretation of data. First, measures of the overall relation between the independent variables and the dependent variable, R^2, an estimate of the proportion of variance acounted for by all the variables or any subset of them, and F tests of the statistical significance of the different R^2 are routinely produced. Second, regression coefficients, both b's and β's, are calculated, with t or F tests of their statistical significance. Third, auxiliary measures to aid interpretation are calculated: squared semi-partial correlations and partial correlations. That interpretation is not easy, as we have repeatedly pointed out, but does not alter this rather remarkable wealth of statistical resources. (p. 445)

Summary

Although limitations in the use of multiple regression analysis have been noted, most can be circumvented by careful planning. Researchers should use fewer unrelated variables, variables should be selected on the basis of theory and factor analysis, and sample size should equal at least 100 subjects. The order of analysis also should be based on theoretical considerations. When these factors are taken into consideration, the multiple regression procedure yields a very powerful and rich analysis of the data.

Chi-square Analysis

"Chi square is a measure of squared deviations between observed and theoretical numbers in terms of frequencies in categories or cells of a table, determining whether such deviations are due to sampling error or some independence or correlation among the frequencies" (Issac & Michael, 1981,

p. 158). The chi-square test is used when a researcher is interested in the number of responses, objects, or people that fall into two or more categories. Huck, Cormier, and Bounds (1974) stated that "this procedure is sometimes called a goodness-of-fit statistic" (p. 216). Goodness-of-fit refers to whether the difference between the expected number of responses and the observed number of responses is significant. "The expected number is what the researcher expects by chance or according to some null hypothesis" (Huck et al., 1974, p. 217). This discrepancy is often reported in terms of a contingency table. It provides "a measure of the discrepancy between the observed cell frequency and those expected on the basis of independence" (Furguson, 1971, p. 183).

Isaac and Michael (1981) discussed the limitations in using chi-square analysis. They state that

> "1. Chi square can only be used with frequency data.
> 2. Chi square requires that the individual events or measures are independent of each other.
> 3. In general, no theoretical frequency should be smaller than 5.
> 4. There must be some logical or empirical basis for the way data are categorized.
> 5. The sum of the expected frequencies and the sum of the observed frequencies must be the same.
> 6. The algebraic sum of the discrepancies between the observed and the corresponding expectancies will be zero." (p. 177)

McNemar (1962) indicated that there are three applications for the chi-square analysis. One application is used when the discrepancy between the observed frequency

differs from the expected frequency on the basis of some a priori principle. He stated that this condition "occurs primarily in genetics research rather than in research of the social sciences" (p. 219).

The second application of chi-square analysis occurs when contingency tables are used. McNemar (1962) described two types of contingency tables. The first uses contingency tables "which are analogous to a correlation table in that both classifications are based on continuous or ordered discrete variables for which we have only categorized information for N individuals" (p. 219). Chi square provides the means for testing the significance of the correlation or association as a chance departure from zero. The significance of the test can be used without knowledge of the degree of correlation. If there is evidence to support a correlation or absence of independence from the chi-square technique, then the strength of the association can be further tested. "The other type of contingency type situation involves classification into categories for one variable vs. classification into unordered groups for the other, or one unordered grouping vs. another" (McNemar, 1962, p. 219). The fundamental problem is likely to involve comparing two or more groups with multiple responses, for example, testing "the difference between groups rather than a measure of correlation" (McNemar, 1962, p. 220).

The third application of chi-square analysis is in relation to goodness-of-fit. It is used to determine if a given frequency distribution, within the limits of chance sampling, can be fit onto a normal or other specified distribution curve. That is, the observed frequency, having the same basic constants as those computed from the expected frequency distribution, can be fit onto the expected frequency curve.

Summary

The chi-square procedure for analysis is used when testing whether "it is probable that two independent groups, which are not necessarily equal in size, have been drawn from populations with the same median" (Issac & Michael, 1981, p. 179). Chi-square analysis provides a test of independence between two or more variables. It describes an association between the variables, but it does not provide an index into the strength of the relationship. It is a procedure which is used when both bivariate dimensions consist of categorical data. It is an index "employed to find the significance of difference between proportions of subjects, objects, events, and so forth, that fall into different categories by comparing observed frequencies and expected frequencies" (Ary, Jacobs, & Racavich, 1972, p. 167).

CHAPTER III
METHODOLOGY

Overview

The primary purpose of this study was to investigate the relationship between the kindergarten performance, as measured by the Metropolitan Readiness Test (MRT), and selected family and child variables of a sample of premature and high-risk children attending public school in Alachua County, Florida. A second purpose was to compare the premature and high-risk children to the general public school population of Alachua County, Florida, in regard to MRT scores, frequency of gender and ethnicity in kindergarten enrollment, rate of special education placement, rate of retention, and rate of absenteeism.

This chapter is divided into seven sections. The first contains a description of the population; in the second the sampling procedure is addressed; a description of the resultant sample is presented next; the fourth contains a discussion of the assessment instrument; the research procedures are detailed in the fifth; the research participant is addressed in the sixth; and the seventh contains a description of the data analysis procedures.

Description of the Population

Low-birth-weight infants comprise approximately 6.8% of the live births in the United States of America (United States Department of Commerce, 1985). In 1983, 245,752 live births were in the premature category (United States Department of Commerce, 1985). According to some estimates, as many as 15.4%, or 37,346, of these children will experience a mild, moderate, or severe handicapping condition per year (Resnick, Bauer, Cupoli, Ausbon, Evans, & Regionalized Perinatal Staff, 1983a).

Keller (1981) discussed the epidemiological characteristics of preterm birth. He stated that

> the more important individual risk factors that have been extensively investigated and that contribute to increases in the rate of low birth weight are mother's race, age, parity, previous pregnancy history, family income and education, cigarette smoking, weight gain during pregnancy and prepregnancy weight. (p. 8)

Keller (1981) reported that within the United States, the South had the largest proportion of infants who weighed less than 2501 grams or who had a gestation of less than 37 weeks. It has been suggested that the increase may be due to the larger proportion of black individuals who reside in the South. The incidence rate for black infants weighing less than 2501 grams has been estimated to be approximately twice that for caucasian infants (Keller, 1981).

In 1973, 30% of the low-birth-weight infants were born to mothers who were 30 years of age or older (National

Center for Health Statistics, 1977). The income level for 18.5% of the families of low-birth-weight infants was less than $7,000 per year (Keller, 1981). An income level between $10,000 and $14,999 per year was reported for another 6% of the families having a low-birth-weight infant (Keller, 1981). Keller (1981) reported that 24.5% of low-birth-weight infants were born to mothers who had less than a twelfth-grade education; this figure was more than twice that found in mother's who had 12 or more years of schooling (Keller, 1981). Thirty-five percent of the mothers with less than 12 years of education were smokers as compared to 14% of those with 12 or more years of school (Keller, 1981). Mothers who smoked one or more packs of cigarettes per day were more than twice as likely to give birth to an infant weighing less than 2501 grams at birth than mothers who smoked less than one pack of cigarettes per day (Keller, 1981).

In summary, it appears that within the United States prematurity may be the result of a number of risk factors. Several factors, such as extremes in maternal age and cigarette smoking, contribute to the increased probability of a premature birth while both income level and educational attainment have been found to be inversely associated with low birth weight. Further, the census data reveal a higher rate of prematurity in black families and in families who live in the South.

Sampling Procedures

The population for the current study was those individuals eligible for participation in the Florida Regional Perinatal Intensive Care Program (RPICP). There were nine regionalized perinatal centers in Florida located in Alachua, Broward, Dade, Duval, Escambia, Hillsborough, Orange, Palm Beach, and Pinellas Counties. All of the centers were established betwen 1978 and 1983. Since 1979, the Department of Pediatrics at Shands Teaching Hospital has collected demographic, medical, developmental, and fiscal data for all patients receiving services from the RPICP throughout Florida. The system utilizes computer terminals at the Regional Perinatal Intensive Care Centers which are linked to the Computing Center at the University of Florida (Resnick, Eitzman, Dickman, Ariet, Ausbon, & Mahan, 1983b). Retrieval of data is readily accessible to authorized personnel. Names and addresses of potential subjects were selected from the existing data base.

All of the subjects considered for participation were born between October, 1975, and September, 1979. The participants in the RPICP during 1975-1981 were selected on the basis of a birth weight of less than 1500 grams or a birth weight of 1500 grams or more with a hospital number ending in 0 or 5 (Resnick et al., 1983b). Forty percent of all the children served by the RPICP were eligible for participation in a follow-up study (Resnick et al., 1983b).

All of the children selected for this study met the RPICP criteria.

The population included children who were enrolled in a public school program. All of the children had taken a standardized achievement measure at the end of their kindergarten year. For children who had been retained in kindergarten, only data from the first year of kindergarten were analyzed.

The public school board office in Alachua County was contacted to secure cooperation for the study. Permission was granted to release the data for the individuals selected for study.

Resultant Sample

The sample of 130 subjects was drawn from the approximately 145 high-risk infants who (a) were born between October 15, 1975, and September 1, 1979, (b) were treated in the Neonatal Intensive Care Unit (NICU) in Shands Teaching Hospital, and (c) were eligible for participation in the RPICP. Only those children who resided in Alachua County were selected for participation in this investigation. Of these children, 25% weighed less than 1500 grams at birth (Resnick et al., 1983). An overall survival rate of 87% was reported by Resnick et al. (1983).

As reported by Resnick et al. (1983), demographic data reveal that 55% of these children were males and that 59% of

the children were black or from other minority groups. Sixty-two percent of the mothers were married; the rest were either unmarried, divorced, or separated from their husbands. An income level of $8,000 per year or less was reported for 49% of the families. Thirty percent of the mothers did not graduate from high school. The mean maternal educational level was reported to be twelfth grade. At the time of their child's birth, 19% of the mothers were teenagers, and 20% were between 30 and 39 years of age. A mean maternal age of 25 years was reported.

Of the 130 subjects selected for the study, 63% were black and 54% were males. Fifty-one percent of the mothers were married, 33% were single, and 16% were divorced or separated from their husbands. An income of less than $8,000 per year was reported for 65% of the families. The mean maternal education level was twelfth grade. Thirty-five percent did not graduate from high school. The mean maternal age was 24 years.

This sample was representative of the larger population from which they were drawn. The demographic description of Florida-born children is comparable to that of children who reside in the South. As such, they constitute a subsample of high-risk infants born within the United States.

Description of the Instruments

The Metropolitan Readiness Test (MRT) was used to measure the achievement levels of the sample. In the Alachua County public school system, kindergarten students were given the MRT. Five scores are derived from the MRT based on visual skills, auditory skills, language skills, prereading skills, and quantitative concepts. The scores (stanines) were compared to national norms.

In addition to the standardized achievement data, student records were used to determine the number of absences students had in a given year. The student records also were reviewed for information regarding retention at the kindergarten level. Data regarding the possible placement of a child in a special education class was garnered from the school records.

Description of the Research Procedures

A selection from 145 children who were hospitalized in the Neonatal Intensive Care Unit in Shands Teaching Hospital and who were born between October 15, 1975, and September 1, 1979, was made. A sample of 130 children with complete data was selected for participation.

After the sample was selected, data were collected from each child's cumulative academic record. The information needed was stored in the cumulative folders at each participant's assigned school.

Demographic data for each child were garnered from the computer files at the RPICP at the Computing Center at the University of Florida and the child's medical records at Shands Teaching Hospital. Information regarding the race, sex, birth weight, and the number of days of hospitalization was available for the sample. Family variables were also stored by the RPICP and the medical records. Data concerning family income, maternal levels of education, and mothers' ages at the time of the child's birth were collected.

Research Participant

Contacts to the individual schools were made by the author. She collected and analyzed the data for each subject in the study. At the time of data collection, the author was enrolled as a doctoral candidate in the College of Education in the Department of Counselor Education at the University of Florida in Gainesville, Florida.

In her graduate course work, the author focused on the areas of measurement and evaluation as applied to children who qualified for special education services. Additional course work centered on social and academic interventions and research methods and techniques. With work experience in evaluating high-risk infants, initiating public school referrals, internships in the public school system, and course work in research methods and techniques, the author

was qualified to collect, analyze, and interpret the data collected for this study.

Data Analyses

Forward, step-wise multiple regression analyses were used to address the first five research questions. The five criterion variables were (a) MRT visual skills, (b) MRT auditory skills, (c) MRT language skills, (d) MRT prereading skills, and (e) MRT quantitative concepts, all during the kindergarten year. The following were the predictor variables for each of these analyses: mother's level of education at the time of the child's birth, mother's age at the time of the child's birth, child's birth weight, and child's number of days of hospitalization during the newborn period.

To analyze differences in MRT scores on the basis of mother's marital status, five one-way analyses of variance were used to answer the first half of research questions 6 through 10. The levels of marital status used were married, single, and divorced or separated. Separate analyses were conducted for MRT auditory skills, MRT visual skills, MRT language skills, MRT prereading skills, and MRT quantitative concepts during the kindergarten year.

To analyze differences in MRT scores on the basis of family level of income at the time of the child's birth, five one-way analyses of variance were used to answer the

second half of research questions 6 through 10. The levels of income were divided into the categories of $0 to $4,000 per year, $4,000 to $8,000 per year, $8,000 to $12,000 per year, and $12,000 and over per year. Separate analyses were conducted for MRT auditory skills, MRT visual skills, MRT language skills, MRT prereading skills, and MRT quantitative concepts, all in the kindergarten year.

To answer research question 11, a chi-square analysis was conducted to test for the goodness-of-fit between the distribution curves of the high-risk children and the general school population on the basis of MRT stanine scores in kindergarten. For research question 12, the difference in the frequency of enrollment rates on the basis of gender and ethnicity between the high-risk children and the general school population was tested by chi-square analysis. To answer research question 13, a chi-square analysis was used. Possible significant differences between the high-risk children and the general school population were evaluated for rate of special education placement, rate of retention, and rate of absenteeism. A chi-square analysis was conducted to answer research question 14. The procedure was used to test for possible significant differences within the high-risk group on MRT scores on the basis of gender and ethnicity.

CHAPTER IV
RESULTS

The results of the study are described in this chapter. The findings are organized by providing a brief description of the sample and then the results in terms of family and child variables in relationship to academic achievement in kindergarten; a comparison of high-risk children to the general school population on the measure of academic achievement, frequency of gender and ethnicity in kindergaraten enrollment, rate of special education placement, retention rates, and rate of absenteeism in kindergarten; and a comparison within the high-risk group on a measure of academic achievement by ethnicity and gender. The chapter concludes with a summary of the findings.

Description of the Sample

A sample of 130 children was selected from NICU graduates in accordance with the criteria specified in Chapter III. Of 145 high-risk children residing in Alachua County, 130 had a complete data set and were included for investigation. All of these children were born between October 15, 1975, and September 1, 1979. All of the

children also had completed the kindergarten year by the end of the 1984-85 school year.

Data on each child's academic performance were collected from each child's cumulative academic record (which was located at each child's assigned school). Data on each child's neonatal course were collected from each child's medical record at Shands Teaching Hospital. The RPICP computer files and the medical records at Shands Teaching Hospital also were the sources for data about each child's family variables.

Questions Concerning the High-risk Children and Their Families

1. What is the relationship between auditory skills on the Metropolitan Readiness Test (MRT) in kindergarten and the mother's level of education at the time of the child's birth, the mother's age at the time of the child's birth, the child's birth weight, and the child's number of days of hospitalization during the newborn period?

To analyze this question, a multiple regression analysis was used. The multiple regression analysis (MRT(AUD) = 1.369 + .000112 BRT + .0025 DNICU + .0022 MOAGE + .2638 MOED, $F = 3.70$, $p < .0167$) revealed that the mother's educational level at the time of the child's birth entered into the equation ($p < .05$) for auditory skills. The proportion of variance in auditory skills explained by

the four variables combined was about 11% (R-square = .1068). These results are presented in Table 1.

Table 1

Multiple Regression Analysis of Auditory Skills on the MRT at Kindergarten and Family and Child Variables

Multiple R	0.3269	Std. error of est.	1.8106
Multiple R-square	0.1068		

Analysis of Variance

	Sum of Squares	DF	Mean Square	F Ratio	P(2 Tail)
Regression	41.5661	4	10.3915	3.170	0.0167
Residual	347.5081	106	3.2784		

Variable		t	P(2 Tail)	Tolerance
Intercept				
BRTHWT	1	0.55	0.58	0.6815
DNICU	2	0.20	0.84	0.6796
MOAGE	3	0.09	0.93	0.9487
MOED	4	3.35	0.00	0.9407

2. What is the relationship between visual skills on the MRT in kindergarten and the mother's level of education at the time of the child's birth, the mother's age at the time of the child's birth, the child's birth weight, and the child's number of days of hospitalization during the newborn period?

A multiple regression analysis was used to answer this question. The multiple regression analysis (MRT(VIS) = 1.519 + .000623 BRT + .0125 DNICU - .0188 MOAGE + .1704

MOED, F = 2.843, $p < .0277$) revealed that the child's birth weight entered into the regression equation ($p < .05$) for visual skills. The proportion of the variance in visual skills explained by the four variables combined was about 10% (R-square = .0969). These results are presented in Table 2.

Table 2

Multiple Regression Analysis of Visual Skills on the MRT at Kindergarten and Family and Child Variables

Multiple R	0.3112	Std. error of est.	2.1208
Multiple R-square	0.0969		

Analysis of Variance

	Sum of Squares	DF	Mean Square	F Ratio	P(2 Tail)
Regression	51.1048	4	12.7852	2.843	0.0277
Residual	476.7612	106	4.4977		

Variable		t	P(2 Tail)	Tolerance
Intercept				
BRTHWT	1	2.62	0.01	0.6815
DNICU	2	0.88	0.38	0.6796
MOAGE	3	-0.66	0.51	0.9487
MOED	4	1.85	0.07	0.9407

3. What is the relationship between language skills on the MRT in kindergarten and the mother's level of education at the time of the child's birth, the mother's age at the time of the child's birth, the child's birth weight,

and the child's number of days of hospitalization during the newborn period?

A multiple regression analysis was used to answer this research question. It was found that both birth weight and the mother's level of education at the time of the child's birth were significant ($p < .05$) in the regression equation (MRT(LANG) = - .437 + .000516 BRT + .0087 DNICU + 0.230 MOAGE + .244 MOED, $F = 4.908$, $p < .0011$). The proportion of the variance in language skills explained by the four variables combined was approximately 16% (R-square = .1563). These results are presented in Table 3.

Table 3

Multiple Regression Analysis of Language Skills on the MRT at Kindergarten and Family and Child Variables

Multiple R	0.3953	Std. error of est.	1.8759
Multiple R-square	0.1563		

Analysis of Variance

	Sum of Squares	DF	Mean Square	F Ratio	P(2 Tail)
Regression	69.0909	4	17.2727	4.908	0.0011
Residual	373.0110	106	3.5190		

Variable		t	P(2 Tail)	Tolerance
Intercept				
BRTHWT	1	2.46	0.02	0.6815
DNICU	2	0.69	0.49	0.6796
MOAGE	3	0.92	0.36	0.9487
MOED	4	2.99	0.00	0.9407

4. What is the relationship between prereading skills on the MRT in kindergarten and the mother's level of education at the time of the child's birth, the mother's age at the time of the child's birth, the child's birth weight, and the child's number of days of hospitalization during the newborn period?

To analyze this question, a multiple regression analysis was used. The multiple regression analysis (MRT(PREREAD) = 1.027 + .000385 BRT + .0080 DNICU - .0050 MOAGE + .225 MOED, $F = 2.936$, $p < .0240$) revealed that the mother's level of education at the time of the child's birth entered into the equation ($p < .05$) for prereading skills. The proportion of the variance in prereading skills explained by the four variables combined was approximately 10% (R-square = .0997). These results are presented in Table 4.

5. What is the relationship between quantitative concepts on the MRT in kindergarten and the mother's level of education at the time of the child's birth, the mother's age at the time of the child's birth, the child's birth weight, and the child's number of days of hospitalization during the newborn period?

Table 4

Multiple Regression Analysis of Prereading Skills on the MRT at Kindergarten and Family and Child Variables

Multiple R	0.3158	Std. error of est.	1.9033
Multiple R-square	0.0997		

Analysis of Variance

	Sum of Squares	DF	Mean Square	F Ratio	P(2 Tail)
Regression	42.5414	4	10.6353	2.936	0.0240
Residual	384.0103	106	3.6227		

Variable		t	P(2 Tail)	Tolerance
Intercept				
BRTHWT	1	1.80	0.07	0.6815
DNICU	2	0.63	0.53	0.6796
MOAGE	3	-0.20	0.84	0.9487
MOED	4	2.71	0.01	0.9407

A multiple regression analysis was used to answer this question. The multiple regression analysis (MRT(QUANT) = -.144 + .000466 BRT + .0132 DNICU + .0242 MOAGE + .214 MOED, $F = 3.769$, $p < .0066$) revealed that both the child's birth weight and the mother's level of education at the time of the child's birth were significant ($p < .05$) in the equation. The proportion of the variance in quantitative skills explained by the four variables combined was about 12% (R-square = .1245). These results are presented in Table 5.

Table 5

Multiple Regression Analysis of Quantitative Concepts on the MRT at Kindergarten and Family and Child Variables

Multiple R	0.3529	Std. error of est.	1.9123
Multiple R-square	0.1245		

Analysis of Variance

	Sum of Squares	DF	Mean Square	F Ratio	P(2 Tail)
Regression	52.1339	4	13.7835	3.769	0.0066
Residual	387.6338	106	3.6569		

Variable		t	P(2 Tail)	Tolerance
Intercept				
BRTHWT	1	2.17	0.03	0.6815
DNICU	2	1.03	0.30	0.6796
MOAGE	3	0.95	0.34	0.9487
MOED	4	2.57	0.01	0.9407

6. What is the difference in the child's auditory skills on the MRT in kindergarten on the basis of the mother's marital status and income level at the time of the child's birth?

To answer the first part of this research question, a one-way analysis of variance (ANOVA) was used. The ANOVA revealed that differences in the mother's marital status were significant for auditory skills ($p < .0499$). In a pair-wise t-test, the difference in the child's score in auditory skills between those with married and single mothers was significant ($p < .0467$). These results are reported in Tables 6, 7, and 8.

Table 6

ANOVA for Auditory Skills on the MRT in Kindergarten with Marital Status

Source of Variation	DF	Sum of Sq.	Mean Sq.	F-value	Prob (2 Tail)
Equality of cell means	2	21.0003	10.5001	3.0814	0.0499
Error	109	371.4270	3.4076		

Table 7

Pair-wise t-tests by Marital Status for Auditory Skills on the MRT in Kindergarten

	Married	Single	Div/Sep
Married	0.0000		
Single	-2.1176	0.0000	
Div/Sep	0.5284	2.0032	0.0000

Note. df = 109

Table 8

Probability Values for Pair-wise t-tests by Marital Status for Auditory Skills in Kindergarten

	Married	Single	Div/Sep
Married	1.0000		
Single	0.0365	1.0000	
Div/Sep	0.5983	0.0467	1.0000

To answer the second half of the question, a one-way ANOVA was used. The results of the analysis procedure revealed a statistically significant difference in auditory skills on the basis of parental income ($p < .0000$). Pair-wise *t*-tests revealed statistically significant differences between the highest income group and those earning $0 to $4,000 per year ($p < .0000$), $4,000 to $8,000 ($p < .0000$) per year, and $8,000 to $12,000 per year ($p < .0002$). These results are reported in Tables 9, 10, and 11.

Table 9

ANOVA by Income Levels for Auditory Skills on the MRT in Kindergarten

Source of Variation	DF	Sum of Sq.	Mean Sq.	F-value	Prob (2 Tail)
Equality of cell means	3	80.9131	26.9710	9.4087	0.0000
Error	107	306.7258	2.8666		

Table 10

Pair-wise t-tests by Income Levels for Auditory Skills on the MRT in Kindergarten

	$0 to $4,000	$4,000 to $8,000	$8,000 to $12,000	$12,000 & Over
$0 to $4,000	0.0000			
$4,000 to $8,000	-0.6310	0.0000		
$8,000 to $12,000	-0.6147	-0.1233	0.0000	
$12,001 & over	4.6446	4.5662	3.8402	0.0000

Note. df = 109

Table 11

Probability Values for Pair-wise t-tests by Income Levels for Auditory Skills on the MRT in Kindergarten

	$0 to $4,000	$4,000 to $8,000	$8,000 to $12,000	$12,000 & Over
$0 to $4,000	1.0000			
$4,000 to $8,000	0.5294	1.0000		
$8,000 to $12,000	0.5400	0.9021	1.0000	
$12,001 & over	0.0000	0.0000	0.0002	1.0000

7. What is the difference in the child's visual skills on the MRT in kindergarten on the basis of the mother's marital status and income level at the time of the child's birth?

A one-way ANOVA was used to answer the first part of this question. The analysis revealed that there was no statistically significant difference ($p < .05$) in the child's visual skills on the basis of the mother's marital status. These results are presented in Tables 12, 13, and 14.

Table 12

ANOVA by Marital Status for Visual Skills on the MRT in Kindergarten

Source of Variation	DF	Sum of Sq.	Mean Sq.	F-value	Prob (2 Tail)
Equality of cell means	2	4.9142	2.4571	0.5115	0.6010
Error	109	523.5757	4.8034		

Table 13

Pair-wise t-tests by Marital Status for Visual Skills on the MRT in Kindergarten

	Married	Single	Div/Sep
Married	0.0000		
Single	-0.9852	0.0000	
Div/Sep	-0.1074	0.5861	0.0000

Note. df = 109

Table 14

Probability Values for Pair-wise t-tests by Marital Status for Visual Skills on the MRT in Kindergarten

	Married	Single	Div/Sep
Married	1.0000		
Single	0.3267	1.0000	
Div/Sep	0.9147	0.5590	1.0000

A one-way ANOVA was used to answer the second half of the research question. The results of the analysis revealed a significant difference in MRT visual skills on the basis of parental income ($p < .0000$). Pair-wise t-tests also were significant between the highest income group and those earning \$0 to \$4,000 per year ($p < .0002$), those earning \$4,000 to \$8,000 per year ($p < .0000$), and those earning \$8,000 to \$12,000 per year ($p < .0009$). These results are presented in Tables 15, 16, and 17.

Table 15

ANOVA by Income Levels for Visual Skills on the MRT in Kindergarten

Source of Variation	DF	Sum of Sq.	Mean Sq.	F-value	Prob (2 Tail)
Equality of cell means	3	95.8027	31.9372	7.9255	0.0000
Error	107	431.1331	4.0293		

Table 16

Pair-wise t-tests by Income Levels for Visual Skills on the MRT in Kindergarten

	$0 to $4,000	$4,000 to $8,000	$8,000 to $12,000	$12,000 & Over
$0 to $4,000	0.0000			
$4,000 to $8,000	-1.2660	0.0000		
$8,000 to $12,000	-0.7080	0.2317	0.0000	
$12,001 & over	3.9312	4.4743	3.4179	0.0000

Note. df = 107

Table 17

Probability Values for Pair-wise t-tests by Income Levels for Visual Skills on the MRT in Kindergarten

	$0 to $4,000	$4,000 to $8,000	$8,000 to $12,000	$12,000 & Over
$0 to $4,000	1.0000			
$4,000 to $8,000	0.2083	1.0000		
$8,000 to $12,000	0.4805	0.8172	1.0000	
$12,001 & over	0.0002	0.0000	0.0009	1.0000

8. What is the difference in the child's language skills on the MRT in kindergarten on the basis of the mother's marital status and income level at the time of the child's birth?

To answer to the first part of this research question, a one-way ANOVA was used. The analysis revealed no statistically significant differences in language skills on the basis of the mother's marital status. Pair-wise t-tests also demonstrated no differences. These results are presented in Tables 18, 19, and 20.

Table 18

ANOVA by Marital Status for Language Skills on the MRT in Kindergarten

Source of Variation	DF	Sum of Sq.	Mean Sq.	F-value	Prob (2 Tail)
Equality of cell means	2	17.7813	8.8907	2.2831	0.1068
Error	109	424.4673	3.8942		

Table 19

Pair-wise t-tests by Marital Status for Language Skills on the MRT in Kindergarten

	Married	Single	Div/Sep
Married	0.0000		
Single	-2.1193	0.0000	
Div/Sep	-0.9544	0.5523	0.0000

Note. df = 109

Table 20

Probability Values for Pair-wise t-tests by Marital Status for Language Skills on the MRT in Kindergarten

	Married	Single	Div/Sep
Married	1.0000		
Single	0.0364	1.0000	
Div/Sep	0.3420	0.5819	1.0000

The second half of the research question was answered by a one-way ANOVA. The analysis revealed a statistically significant difference in language skills on the basis of parental income ($p < .0000$). Pair-wise *t*-tests also were significant between the highest income group and those reporting an income of $0 to $4,000 per year ($p < .0000$), those reporting an income of $4,000 to $8,000 per year ($p < .0002$), and those reporting an income of $8,000 to $12,000

per year ($p < .0002$). These results are presented in Tables 21, 22, and 23.

Table 21

ANOVA by Income Levels for Language Skills on the MRT in Kindergarten

Source of Variation	DF	Sum of Sq.	Mean Sq.	F-value	Prob (2 Tail)
Equality of cell means	3	96.5524	32.1841	9.9657	0.0000
Error	107	345.5549	3.2295		

Table 22

Pair-wise t-tests by Income Levels for Language Skills on the MRT in Kindergarten

	$0 to $4,000	$4,000 to $8,000	$8,000 to $12,000	$12,000 & Over
$0 to $4,000	0.0000			
$4,000 to $8,000	0.8530	0.0000		
$8,000 to $12,000	-0.1336	-0.7130	0.0000	
$12,001 & over	5.2518	3.8590	3.8412	0.0000

Note. df = 107

Table 23

Probability Values for Pair-wise t-tests by Income Level for Language Skills on the MRT in Kindergarten

	$0 to $4,000	$4,000 to $8,000	$8,000 to $12,000	$12,000 & Over
$0 to $4,000	1.0000			
$4,000 to $8,000	0.3955	1.0000		
$8,000 to $12,000	0.8939	0.4774	1.0000	
$12,001 & over	0.0000	0.0002	0.0002	1.0000

9. What is the difference in the child's prereading skills on the MRT in kindergarten on the basis of the mother's marital status and income level at the time of the child's birth?

A one-way ANOVA was used to answer the first part of this research question. The analysis revealed no statistically significant difference in the child's prereading skills on the basis of the mother's marital status. Pair-wise *t*-tests also demonstrated no statistically significant differences. These results are presented in Tables 24, 25, and 26.

Table 24

ANOVA by Marital Status for Prereading Skills on the MRT in Kindergarten

Source of Variation	DF	Sum of Sq.	Mean Sq.	F-value	Prob (2 Tail)
Equality of cell means	2	8.4341	4.2171	1.0927	0.3390
Error	109	420.6719	3.8594		

Table 25

Pair-wise t-tests by Marital Status for Prereading skills on the MRT in Kindergarten

	Married	Single	Div/Sep
Married	0.0000		
Single	-1.3381	0.0000	
Div/Sep	0.1541	1.0898	0.0000

Note. df = 109

Table 26

Probability Values for Pair-wise t-tests by Marital Status for Prereading Skills on the MRT in Kindergarten

	Married	Single	Div/Sep
Married	1.0000		
Single	0.1837	1.0000	
Div/Sep	0.8778	0.2782	1.0000

To answer the second half of the question, a one-way ANOVA was used. The results revealed a statistically significant difference in prereading skills on the basis of parental income ($p < .0000$). Pair-wise t-tests also were significant between the highest income group and those earning \$0 to \$4,000 per year ($p < .0000$), \$4,000 to \$8,000 per year ($p < .000$), and \$8,000 to \$12,000 per year ($p < .0001$). These results are presented in Tables 27, 28, and 29.

Table 27

ANOVA by Income Levels for Prereading Skills on the MRT in Kindergarten

Source of Variation	DF	Sum of Sq.	Mean Sq.	F-value	Prob (2 Tail)
Equality of cell means	3	92.2594	30.7531	9.8274	0.0000
Error	107	334.8389	3.1293		

Table 28

Pair-wise t-tests by Income Levels for Prereading Skills on the MRT in Kindergarten

	$0 to $4,000	$4,000 to $8,000	$8,000 to $12,000	$12,000 & Over
$0 to $4,000	0.0000			
$4,000 to $8,000	-1.0381	0.0000		
$8,000 to $12,000	-0.8712	-0.0751	0.0000	
$12,001 & over	4.5269	4.8028	3.9857	0.0000

Note. df = 107

Table 29

Probability Values for Pair-wise t-tests by Income Levels for Prereading Skills on the MRT in Kindergarten

	$0 to $4,000	$4,000 to $8,000	$8,000 to $12,000	$12,000 & Over
$0 to $4,000	1.0000			
$4,000 to $8,000	0.3016	1.0000		
$8,000 to $12,000	0.3856	0.9403	1.0000	
$12,001 & over	0.0000*	0.0000*	0.0001*	1.0000

10. What is the difference in the child's quantitative concepts on the MRT in kindergarten on the basis of the mother's marital status and income level at the time of the child's birth?

A one-way ANOVA was used to answer the first part of this research question. The results revealed no statistically significant differences in the child's quantitatiave concepts on the basis of the mother's marital status. Pair-wise t-tests, however, were significant between mothers who were married and mothers who were single ($p < .0373$). These results are presented in Tables 30, 31, and 32.

Table 30

ANOVA by Marital Status for Quantitative Concepts on the MRT in Kindergarten

Source of Variation	DF	Sum of Sq.	Mean Sq.	F-value	Prob (2 Tail)
Equality of cell means	2	17.4318	8.7159	2.2250	0.1130
Error	109	426.9868	3.9173		

Table 31

Pair-wise t-tests by Marital Status for Quantitative Concepts on the MRT in Kindergarten

	Married	Single	Div/Sep
Married	0.0000		
Single	-2.1087	0.0000	
Div/Sep	-0.7477	0.7473	0.0000

Note. df = 109

Table 32

Probability Values for Pair-wise t-tests by Marital Status for Quantitative Concepts on the MRT in Kindergarten

	Married	Single	Div/Sep
Married	1.0000		
Single	0.0373	1.0000	
Div/Sep	0.4563	0.4565	1.0000

A one-way ANOVA was used to answer the second half of the question. The results of the analysis revealed a statistically significant difference ($p < .05$) in the child's quantitative concepts on the basis of parental income. Pair-wise *t*-tests also demonstrated statistically significant differences between the highest income group and those reporting an income of \$0 to \$4,000 per year ($p < .0000$), \$4,000 to \$8,000 per year ($p < .0000$), and \$8,000 to

$12,000 ($p < .0002$). These results are presented in Tables 33, 34, and 35.

Table 33

ANOVA by Income Levels for Quantitative Concepts on the MRT in Kindergarten

Source of Variation	DF	Sum of Sq.	Mean Sq.	F-value	Prob (2 Tail)
Equality of cell means	3	109.6155	36.5385	12.1865	0.0000
Error	107	320.8167	2.9983		

Table 34

Pair-wise t-tests by Income Levels for Quantitative Concepts on the MRT in Kindergarten

	$0 to $4,000	$4,000 to $8,000	$8,000 to $12,000	$12,000 & Over
$0 to $4,000	0.0000			
$4,000 to $8,000	0.6352	0.0000		
$8,000 to $12,000	-0.1965	-0.6194	0.0000	
$12,001 & over	5.7562	4.4792	4.2548	0.0000

Note. df = 107

Table 35

Probability Values for Pair-wise t-tests by Income Levels for Quantitative Concepts on the MRT in Kindergarten

	$0 to $4,000	$4,000 to $8,000	$8,000 to $12,000	$12,000 & Over
$0 to $4,000	1.0000			
$4,000 to $8,000	0.5266	1.0000		
$8,000 to $12,000	0.8446	0.5370	1.0000	
$12,001 & over	0.0000	0.0000	0.0001	1.0000

Questions Concerning the High-risk Children and the General School Population

Three research questions addressed the comparison of the high-risk children to the general school population. These research questions were as follows:

11. What are the differences in auditory skills, visual skills, language skills, prereading skills, and quantitative concepts on the MRT in kindergarten between the high-risk children and the general school population?

A chi-square analysis was used to answer this question. No Alachua County norms were available for

the five stanine scales. However, the scales were based on nationally normalized scores. Therefore, the MRT scores for the high-risk children were compared to the expected normal frequency distribution. None of the values differed significantly ($p < .05$), which indicated that the MRT scores attained by the high-risk children did not differ significantly from the normal distribution. These results are presented in Table 36.

12. What are the differences between high-risk children and the general school population on the frequency of gender or ethnicity in kindergarten enrollment.

This question also was addressed by chi-square analysis procedures. The results revealed that significantly more black chidren were represented in the high-risk group than were found in the general school enrollment in kindergarten ($X^2(1) = 16.44$, $p < .001$). These results are presented in Table 37.

To answer the second half of the question, another chi-square analysis was used. No statistical difference was found in the frequency of enrollment, based on gender, between the high-risk children and the general school population ($X^2(1) = .14$, p = NS). These results are reported in Table 38.

Table 36

Summary of High-risk Children's Stanines on MAT and Chi-square Test Against Normal Expected Values

Stanine	1	2	3	4	5	6	7	8	9	Mean	Chi-sq.
Audit.	2	6	23	21	24	15	11	8	4	4.86	.98
Visual	5	13	14	22	19	12	12	9	8	4.88	1.23
Lang.	9	12	14	30	13	18	9	6	3	4.44	1.92
Preread.	6	10	21	22	15	18	12	7	3	4.55	.77
Quant.	5	16	26	19	20	9	8	9	2	4.08	2.86
Normal expected values	4.6	7.5	13.8	19.9	22.5	19.9	13.8	7.5	4.6		

Note. df = 32

Table 37

Contingency Table for the High-risk Children and the General School Population on the Basis of Ethnicity

	Black	White	Chi-square	Alpha
High risk	62.8	37.2	16.44	< .001
General school population	32.9	64.1		

Note. df = 1

Table 38

Contingency Table for the High-risk Children and the General School Population on the Basis of Gender

	Male	Female	Chi-square	Alpha
High risk	45.8	54.2	.14	NS
General school population	48.4	51.6		

Note. df = 1

13. What are the differences in the rate of special education placement, rate of retention, or rate of absenteeism between the high-risk children and the general school population during kindergarten?

The overall enrollment rate in special education programs for the high-risk children was 46% in comparison to an overall special education rate of 13.3% for Alachua County students. The Alachua County placement data were for grades K-12, inclusive. Testing the enrollment on a percentage basis with chi-square analysis for each of the programs revealed that the placement rate for the high-risk children was significantly higher in programs for the trainable mentally handicapped (TMH, $p = < .05$), speech and language therapy (SL, $p < .001$), and the physically impaired (PI, $p < .05$). Enrollment in classes for the hearing impaired (HI, $p < .10$) was nearly significant for the high-risk children. These results are presented in Table 39.

Retention rates for high-risk children were compared to those for the general school population by chi-square analysis. The data for the general school population were reported for kindergarten students enrolled in the Alachua County public schools. Although chi-square analysis revealed that there was no statistically significant association between the high-risk children's retention and the general school population's ($X^2(1) = 3.16$, $p < .10$), the retention rate for the high-risk children was nearly twice that than was found in the general school population. These results are reported in Table 40.

Table 39

Contingency Tables Comparing the Percentage of Enrollment in Special Education Programs Between the High-risk children (H.R.) and the General School Population (G.S.) in Alachua County

Program	Group	+	-	Chi-square	Alpha
EMH	H.R.	.8	99.2	.03	
	G.S.	.6	99.4		
TMH	H.R	5.5	94.5	4.54	<.05
	G.S.	.4	99.6		
SL	H.R.	25.2	74.8	17.58	<.001
	G.S.	4.2	95.8		
PI	H.R.	4.7	95.3	3.97	<.05
	G.S.	.3	99.7		
HI	H.R.	3.9	96.1	3.68	<.10
	G.S.	.1	99.9		
VI	H.R.	1.6	98.4	1.47	
	G.S.	.1			
EH	H.R.	2.4	97.6	.27	
	G.S.	1.4	98.6		
GIFT	H.R.	3.1	96.9	1.08	
	G.S.	6.2	93.8		

Note. EMH = educable mentally handicapped; TMH = trainable mentally handicapped; SL = speech and language therapy; PI = physically impaired; HI = hearing impaired; VI = visually impaired, EH = emotionally handicapped; and GIFT = gifted, df = 7.

Table 40

Contingency Table on Percentage Basis for Retention Rates for the High-risk Children and the General School Population

	Ret	Pass	Chi-square	Alpha
High-risk	12.6	87.4	3.16	<.10
General school population	5.4	97.6		

Note. df = 1

The data for the rate of absenteeism for the students of Alachua County public school system were reported in terms of the rate of attendance. An attendance rate of 96% was reported for the 180-day school year. This yielded an average attendance rate of 172.8 days or an average of 7.2 days absence for the general school population. The mean number of days of absence for the high-risk children was 10.7 days. Because the attendance rate was reported for grades K-12 inclusive and no standard deviation was reported for the Alachua County students, no statistical analysis was conducted.

Questions Concerning the High-risk Children

14. What are the differences in auditory skills, visual skills, language skills, prereading skills, and quantitative concepts on the MRT in kindergarten within the high-risk group on the basis of gender and ethnicity?

The question of gender and ethnicity on the high-risk children's performance on each of the MRT scales was addressed by chi-square analyses. In testing the difference between the mean scores of white children and black children in the high-risk group, it was found that the mean scores for the white children were significantly higher ($p < .0001$) than for the black children on all of the MRT scales. These results are reported in Table 41.

Table 41

Comparison of MRT Scores in Kindergarten between Black and White High-risk Children

Scale	Mean (B)	Mean (W)	z-score	Alpha
AUD	4.268	5.905	6.878	<.0001
VIS	4.389	5.643	4.324	<.0001
LANG	3.817	5.381	6.157	<.0001
PREREAD	4.070	5.511	5.909	<.0001
QUANT	3.761	5.310	6.075	<.0001

Note. df = 4

The difference between the mean performance on the MRT scales by the high-risk males and females also was tested by chi-square analysis. A significant difference favoring the males was found in language skills ($p = .05$). The differences between the males and females on the other MRT

scales were not significant. These results are presented in Table 42.

Table 42

Comparison of MRT Scores in Kindergarten between Male and Female High-risk Children

Scale	Mean (M)	Mean (F)	z-score	Alpha
AUD	4.967	4.722	.988	
VIS	5.017	4.537	1.644	<.10
LANG	4.700	4.111	2.240	<.05
PREREAD	4.733	4.519	.813	
QUANT	4.335	4.259	.287	

Note. df = 4

Summary of Findings

In comparing the overall achievement scores between the high-risk children and the general school population, no significant differences were found between the two groups on the MRT in kindergarten. However, there were significant differences in the achievement on the MRT in kindergarten within the high-risk group. The family variables of parental income and mother's level of education were found to contribute significantly to a child's performance on the MRT in kindergarten. The high-risk children's ethnicity and birth weight also contributed to performance on the MRT in kindergarten. The child's gender was found to contribute

significantly in the area of language skills on the MRT in kindergarten.

The high-risk children were found to have a higher rate of special education placement than the general school population in Alachua County. Significantly higher rates of placement for the high-risk group were found in programs for the trainable mentally handicapped, the physically impaired, and speech and language therapy. It was noted that the rates of special education placement for Alachua County students was reported for grades K-12 inclusive.

Chi-square analysis revealed a statistically significant difference ($p < .05$) in the frequency of enrollment on the basis of ethnicity in kindergarten between the high-risk children and the general school population. The enrollment rate for black high-risk chidren was significantly higher than was found in the general school population. However, significant differences were noted in the frequency of enrollment in kindergarten on the basis of gender between the high-risk children and the general school population. Chi-square analysis also revealed no statistically significant differences between the high-risk children and the general school population in Alachua County public schools in their rates of retention in kindergarten. No inferential statistical analysis procedure was conducted to test the difference in the rates of absenteeism between the high-risk children and the general school population in

Alachua County public schools because the Alachua County School Board did not separate the attendance rate for students by grade level nor did they compute a standard deviation for the attendance rate.

CHAPTER V
DISCUSSION

The primary purpose of this study was to investigate the relationship between the kindergarten performance, as measured by the Metropolitan Readiness Test (MRT), and selected family and child variables of a sample of premature and high-risk children attending public school in Alachua County, Florida. A second purpose was to compare the premature and high-risk children to the general public school population of Alachua County, Florida, in regard to MRT scores, frequency of gender and ethnicity in kindergarten enrollment, rate of special education placement, rate of retention, and rate of absenteeism. The family factors included parental income at the time of the child's birth, maternal age at the time of the child's birth, and maternal educational level. The variables for the high-risk children were birth weight, number of days of hospitalization in the NICU, gender, and ethnicity.

The high-risk children were selected from a group of 145 NICU graduates who were enrolled in the Alachua County public school system. Of this group, 130 children had complete data sets and were included in the study. Information concerning the family variables was gathered from RPICP

computer files and each child's medical record at Shands Teaching Hospital. Data concerning each child's neonatal course were obtained from RPICP computer files and medical record from Shands Teaching Hospital. Each child's cumulative academic record was reviewed at the child's assigned school to obtain MRT scores, number of days of absence, retention, and placement (or lack of it) in a special education program. The measure of achievement used in this study was each child's score on the individual scales of the MRT. The MRT scores for the high-risk children also were compared to those of the national norming sample for the MRT. The rate of special education placement for the high-risk children was compared to the special education enrollment figures for Alachua County public school students in grades K-12. The rate of retention for the high-risk children was compared to that of kindergarten students enrolled in the Alachua County public school system. No inferential statistical comparisons of rate of absenteeism for high-risk children and the general school population of Alachua County public school students could be made.

The data were analyzed by means of multiple regression analyses, one-way analyses of variance, and chi-square statistics. The multiple regression analysis was used to determine the relationship between the family factors of maternal age at the time of the child's birth and maternal educational level and the child factors of birth weight and

the number of days of hospitalization in the NICU during the newborn period and MRT scores. One-way analysis of variance procedures were used to explore the possible differences in MRT scores on the bases of parental income at the time of the child's birth and marital status. Pair-wise t-tests were used as follow-up procedures for the one-way analyses of variance. Chi-square statistics were used to compare the high-risk children to the general school population on MRT scores, rate of special education placement, and rate of retention. Comparisons on the basis of gender and ethnicity were made by chi-square procedures between the high-risk children and the general public school population of Alachua County. Chi-square analyses also were used within the high-risk group to determine the relationship between gender and ethnicity and MRT scores.

Limitations to Generalizability

The results of this study have limitations regarding generalizability. The investigation was limited to kindergarten students who had been hospitalized in the NICU at Shands Teaching Hospital during the newborn period and who were enrolled in the Alachua County public school system. Further, the measures of achievement were limited to scores on the five scales of the MRT. In addition, the data concerning enrollment in special education classes in the Alachua County public school system were reported for

grades K-12. Therefore, they may not be representative of the special education enrollments for kindergarten students. For example, enrollment in some special education programs (e.g., speech and language therapy) has been largely limited to early elementary students, whereas other special education programs (e.g., programs for emotionally handicapped or educably mentally retarded students) traditionally have not been open to kindergarten students.

Another limitation concerns the exclusion of children who were unable to take the MRT. These included all of those placed in classes for the trainable mentally handicapped and some of those placed in special education classes for the physically impaired and hearing impaired. Thus, the more educationally handicapped students were excluded from the analyses of academic achievement.

Findings and Conclusions

Family Variables and Academic Achievement

The variables which were most significant in the academic achievement of high-risk children were the mother's level of education and parental income. To a lesser extent, marital status of the parent had an influence on one subtest of the MRT. The high-risk children who had higher achievement scores on the MRT were those whose mothers had at least completed high school and who earned $12,000 or more per year. The high-risk children who had poor achievement

scores on the MRT tended to be those whose mothers had less than a twelfth-grade education and who earned less than $12,000 per year.

Child Variables and Academic Achievement

The most significant factors related to achievement scores on the MRT for the high-risk children were ethnicity and gender. High-risk children who were white and who had larger birth weights had higher levels of achievement on the MRT than did black children of lower birth weight. Gender had a slight influence on one scale of the MRT in favor of the males. This result was somewhat surprising; however, it may have been influenced by an underrepresentation of white females in the study.

High-risk Children in Comparison to the General School Population

There was no significant difference in overall academic achievement on the MRT between the high-risk children and the general school population. The results of this comparison may have been influenced by the exclusion of children who were most educationally handicapped. All of the students who were enrolled in special education programs for the trainable mentally handicapped and some of the high-risk children who were enrolled in special education classes for the physically impaired and hearing impaired were not given the MRT. Thus, the achievement results may be

applicable only to those high-risk children without severe handicapping conditions.

Despite having an overall academic achievement level that was not significantly different from the general school population, high-risk children had a special education placement rate which greatly exceeded the general public school population of Alachua County. An overall special education placement rate of 43% was reported for the high-risk group in comparison to a placement rate of 13.3% for students enrolled in the Alachua County public school system. Also, significantly more high-risk children were placed in programs for speech and language therapy, the trainable mentally handicapped, and the physically impaired than was found in the general school population. Further, it was noted that, although the difference was statistically nonsignificant, the placement rate for high-risk children in programs for the hearing impaired was nearly four times that of the general school population. These results were consistent with those of Harbaugh (1983).

To summarize, the results of this study reflected that kindergarten children who were placed in the NICU at Shands Teaching Hospital as newborns had levels of achievement which were indistinguishable from the general school population. They were, however, more likely to be placed in special education programs than was the general school population. Birth weight was a significant factor in the

academic achievement of high-risk infants as were the socio-economic factors of ethnicity, parental income, and educational level of the parent. Therefore, it appears that there is an interaction between the biological status of the child and environmental factors of the family which contribute to special education placement in kindergarten.

Implications

The study of high-risk children at school age has several important implications for education and training. Within the public school system, sex education or health education curricula could be expanded to include a unit on the impact of high-risk birth. It also could include information on the prevention of high-risk birth through proper diet during pregnancy, the importance of abstaining from cigarette smoking or alcohol consumption during pregnancy, and the importance of prenatal care. The programs could include the availability of local health care services to expectant mothers and newborn children.

In the area of teacher training, the curriculum in programs for early childhood education, elementary education, and special education at the university level could be expanded to include topics on the identification of, and intervention with, high-risk children. For example, school psychology programs could include courses in the evaluation and treatment of high-risk infants and children.

Further, medical training programs for nurses and physicians could include the identification of children at risk for developmental delay. In addition, in-service training for day-care, Head Start workers and teachers could cover information and training in the use of screening instruments to detect those children at risk for possible developmental delay. Emphasis also could be placed on intervention techniques for high-risk children.

Recommendations for Further Research

Because this study reflected an association between low birth weight and certain socio-economic factors and placement in special education programs in kindergarten, additional research could explore the academic progress of high-risk children in later school years. Further, this study could be replicated in other parts of the United States to increase the generalizability of the results.

In addition, recent federal legislation (PL 99-457) has been adopted in several states within the United States. This legislation mandates the identification and treatment of high-risk infants and children up to 3 years of age. Research efforts therefore could be directed towards the development of appropriate assessment instruments for identifying those children who are at risk for delay and to measure treatment outcomes. Because intervention techniques to prevent long-term handicapping conditions are included as

part of the legislative concern, research also should be established to define the goals and effectiveness of various treatment modes.

Further, PL 94-142 (Education for All Handicapped Children) mandates that preschool programs for handicapped children ages 3 to 5 years be established in every state by 1990. Because a large number of high-risk children will be placed in these programs, research efforts could be directed towards the effectiveness of this type of placement upon later academic progress.

Summation

The results of this study reflect that current educational practices are effective in achieving reasonable and desirable educational achievement outcomes for high-risk children. However, the curricular (and relatedly, economic) "prices" paid to achieve those outcomes are disproportionately high for high-risk children. Therefore, further efforts should be made to identify both other effects and associated factors of high-risk birth and methods to achieve reasonable educational outcomes at lower educational, psychological, and economic costs.

REFERENCES

Alden, E., Mandelkorn, T., Woodrum, D. E., WennberG, R. P., Parks, C. R., & Hodson, W. A. (1972). Morbidity and mortality of infants weighing <1000 grams in an intensive care nursery. Pediatrics, 50, 40-49.

Alm, I. (1953). The long term prognosis for prematurely born children: A follow-up study of 999 premature boys born in wedlock and of 1002 controls. Acta Paediatrica, 42 (Supplement 94), 1-116.

Ary, D., Jacobs, L., & Racavich, A. (1972). Introduction to research in education (2nd ed.). New York: Holt, Rinehart, and Winston.

Asher, C. (1946). The prognosis of immaturity. British Medical Journal, 1, 793-796.

Bacola, E., Behrle, F. C., DeSchweinitz, L., Miller, H. C., & Mira, M. (1966a). Perinatal and environmental factors in late neurologic sequelae. I: Infants having birth weights under 1500 grams. American Journal of Diseases of Children, 112, 359-368.

Bacola, E., Behrle, F. C., DeSchweinitz, L., Miller, H. C., & Mira, M. (1966b). Perinatal and environmental factors in late neurologic sequelae. II: Infants having birth weights from 1500 to 2500 grams. American Journal of Diseases of Children, 112, 369-374.

Balow, B., Anderson, J. A., Reynolds, M., & Rubin, R. (1969). Educational and behavioral sequelae of prenatal and perinatal conditions. Educational Follow-up Project Interim Report (no. 3), Minneapolis: University of Minnesota.

Balow, I., Farr, R., Thomas, P. H., & Prescott, G. (1978). The Metroppolitan Achievement Tests (5th ed.). New York: The Psychological Corporation.

Barlow, A. (1945). Prognosis in prematurity. Archives of Diseases in Childhood, 20, 184-185.

Benton, A. (1940). Mental development of prematurely born children: A critical review of the literature. American Journal of Orthopsychiatry, 10, 719-746.

Berkow, R. (Ed.). (1982). The Merck manual of diagnosis and therapy (14th ed.). Rahway, NJ: Merck Sharp and Dohme Research Laboratories.

Beskow, B. (1949). Mental disturbances in premature children at school age. Acta Paediatrica, 37, 125-149.

Blegen, S. D. (1952). The premature child: The incidence, aetiology, mortality and the fate of survivors. Acta Paediatrica, 42 (Supplement 88), 1-71.

Bloom, B. S. (1964). Stability and change in human characteristics. New York: John Wiley and Sons.

Broman, S. H. (1979). Perinatal anoxia and cognitive development in early childhood. In T. Martini, A. M. Sostek, S. Goldberg, & H. H. Schuman (Eds.), Infants born at risk: Behavior and development (pp. 29-52). New York: Spectrum Publications.

Bruner, J. (1960). The process of education. Cambridge, MA: Harvard University Press.

Butterfield, L. J. (1983). The impact of regionalization on neonatal outcome. In G. Smith, D. Vidyasagar, & P. Smith (Eds.), Historical review and recent advances in neonatal and perinatal medicine, Vol. II (pp. 107-123). Sommerville, NJ: Mead-Johnson Nutritional Division.

Capper, A. (1928a). The fate and development of the immature and of the premature child: A clinical study, a review of the literature, and study of cerebral hemorrhage in the newborn infant. I. American Journal of Diseases in Childhood, 35, 262-288.

Capper, A. (1928b). The fate and development of the immature and of the premature child: A clinial study, a review of the literature, and study of cerebral hemorrage in the newborn infant. II. American Journal of Diseases in Childhood, 35, 443-491.

Caputo, D. V., Goldstien, K. M., & Taub, H. B. (1979). The development of prematurely born children through middle childhood. In T. Field, A. M. Sostek, S. Goldberg, & H. H. Schuman (Eds.), Infants born at risk: Behavior and development (pp. 219-247). New York: Spectrum Publications.

Cassady, G. (1970). Body composition in interuterine growth retardation. Pediatric Clinics of North America, 17, 79-99.

Chickermane, A. S., Majumdar, G. R., & Shas, A. P. (1969). The use of maturity score in the assessment of gestational age of newborn babies with special reference to prematurity. Indian Pediatrics, 6, 720-728.

Cohen, S. E., & Parmelee, A. H. (1983). Prediction of five year Stanford-Binet scores in preterm infants. Child Development, 54, 1242-1253.

Commey, J. O. O., Ashby, S. A., & Fitzhardinge, P. M. (1978). Handicap in the preterm small-for-gestational age (SGA) infant. Pediatric Research, 12, 550.

Commey, J. O. O., & Fitzhardinge, P. M. (1979). Handicap in the pre-term small-for-gestational age infant. The Journal of Pediatrics, 94, 779-786.

Corrigan, F. C., Berger, S. I., Dienstbier, R. A., & Strok, E. S. (1967). The influence of prematurity on school performance. American Journal of Mental Deficiency, 71, 533-535.

Crosse, V. M. (1945). Care of the premature baby with special reference to babies born in its own home. Practitioner, 154, 26-32.

Dann, M., Levine, S. Z., & New, E. (1958). The development of prematurely born children with birthweights or minimal postnatal weights of 1000 grams or less. Pediatrics, 22, 1037-1053.

Dann, M., Levine, S. Z., & New, E. (1964). A long term follow-up study of small premature infants. Pediatrics, 33, 945-955.

Davies, P. A., & Stewart, A. L. (1975). Low birthweight infants: Neurological sequelae and later intelligence. British Medical Journal, 31, 85-91.

Davis, D. C. (1951). Comparative study of the growth and development of premature and full term children with special reference to oral communication. (Doctoral dissertation, Northwestern University, Evanston, 1952). Dissertation Abstracts International, 13, 36.

DeHirsch, K., Jansky, J., & Langford, W. (1966). Comparisons between prematurely born children at three age levels. American Journal of Orthopsychiatry, 36, 616-628.

Dinwiddie, R., Mellor, D. H., Donaldson, S. H. C., Tunstall, M. E., & Russell, G. (1974). Quality of survival after artificial ventilation of the newborn. Archives of Diseases in Childhood, 49, 703-710.

Doehring, D. G. (1968). Patterns of impairment in specific reading disability: A neuro-psychological investigation. Dissertation Abstracts International, 29, 2132-B. (University Microfilms No. 68-16, 526)

Douglas, J. W. B. (1956). Mental ability and school achievement of premature children at 8 years of age. British Medical Journal, 1, 1210-1214.

Douglas, J. W. B., & Gear, R. (1976). Children of low birth weight in the 1946 national cohort: Behaviour and achievement in adolescence. Archives of Diseases in Childhood, 51, 820-827.

Drillien, C. M. (1958a). A longitudinal study of the growth and development of prematurely and maturely born children: Part I. Introduction. Archives of Diseases in Childhood, 33, 417-422.

Drillien, C. M. (1958b). Growth and development in a group of children of very-low-birthweight. Archives of Diseases in Childhood, 33, 10-18.

Drillien, C. M. (1959). A longitudinal study of the growth and development of prematurely and maturely born children. Part VII: Mental development at 2 to 5 years. Archives of Diseases in Childhood, 36, 233-240.

Drillien, C. M. (1961a). A longitudinal study of the growth and development of prematurely and maturely born children. Part II: Mental development. Archives of Diseases in Childhood, 36, 37-45.

Drillien, C. M. (1961b). The incidence of mental and physical handicaps in school age children of very-low-birthweight. Pediatrics, 27, 452-464.

Drillien, C. M. (1967). The incidence of mental and physical handicaps in school age children of very-low-birthweight. II. Pediatrics, 39, 238-247.

Drillien, C. M. (1972a). Abnormal neurologic signs in the first year of life in low-birthweight infants: Possible prognostic significance. Developmental Medicine and Child Neurology, 14, 575-584.

Drillien, C. M. (1972b). Aetiology and outcome in low-birthweight infants. Developmental Medicine and Child Neurology, 14, 563-574.

Drillien, C. M., Thomson, A. J., & Burgoyne, K. (1980). Low-birthweight children at early school age: A longitudinal study. Developmental Medicine and Child Neurology, 22, 26-47.

Eames, T. H. (1945). Comparison of premature and full term birth who fail in reading. The Journal of Educational Research, 38, 506-508.

Eames, T. H. (1959). The effect of endocrine disorders on reading. The Reading Teacher, 12, 263-265.

Ehrlich, C., & Shapiro, E. (1973). Communication skills in five year old children with high risk neonatal histories. Journal of Speech and Hearing Research, 16, 522-529.

Fitzhardinge, P. M. (1976). Follow-up studies on the low birth weight infant. Clinics in Perinatology, 3, 503-516.

Fitzhardinge, P. M. (1978). Follow-up studies in infants treated by mechanical ventilation. Clinics in Perinatology, 5, 451-461.

Fitzhardinge, P. M., Kalman, E., Ashby, S., & Pape, K. E. (1978). Present status of the infant of very low birth weight treated in a referral neonatal intensive care unit in 1974. In K. Elliot & S. O'Connor (Eds.), Major mental handicaps (pp. 139-150). Amsterdam: Elsevier-Excerpta Medica.

Fitzhardinge, P. M., Pape, K., Arstikaitis, M., Boyle, M., Ashby, S., Rowley, A., Netley, C., & Swyer, P. R. (1976). Mechanical ventilation of infants less than 1501 gm birth weight: Health, growth and neurologic sequelae. Journal of Pediatrics, 88, 531-541.

Fitzhardinge, P. M., & Ramsay, M. (1973). The improving outlook for the small prematurely born infant. Developmental Medicine and Child Neurology, 15, 447-459.

Francis-Williams, J., & Davies, P. (1974). Very low birthweight and later intelligence. Developmental Medicine and Child Neurology, 16, 709-728.

Frisk, M., Takkunen, R-L., & Holmstrom, G. (1963). Small prematures at 6-7 years of age. II: School maturity. Annals Paediatriae Fenniae, 9, 197-212.

Furguson, G. (1971). Statistical analysis in psychology and education (3rd ed.). New York: McGraw-Hill.

Galante, M. B., Flye, M. E., & Stephens, L. S. (1972). Cumulative minor deficits: A longitudinal study of the relation of physical factors to school achievement. The Journal of Learning Disabilities, 5, 75-80.

Gesell, A. (1933). The mental growth of prematurely born infants. Journal of Pediatrics, 2, 676-680.

Gronlund, N. E. (1978). Review of the Metropolitan Achievement Tests. In O. K. Buros (Ed.), The mental measurements yearbook (8th ed.) (pp. 65-67). Highland Park, NJ: Gryphon Press.

Gunn, T., Lepore, E., & Outerbridge, E. (1983). Outcome at school-age after mechanical ventilation. Developmental Medicine and Child Neurology, 25, 305-314.

Hack, M., Fanaroff, A. A., & Merkatz, I. R. (1979). The low-birth-weight infant: Evolution of a changing outlook. New England Journal of Medicine, 301, 1162-1165.

Haertel, E. H. (1985). Review of the Metropolitan Achievement Tests. In J. V. Mitchell, Jr. (Ed.), The mental measurements yearbook (9th ed.) (Vol. I, pp. 963-965). Lincoln, NE: University of Nebraska Press.

Harbaugh, G. R. (1983). Costs and "out of pocket" costs of rearing the handicapped child. Unpublished manuscript, 1-30.

Harper, P., Fischer, L., & Rider, R. (1959). Neurological and intellectual status of prematures at three to five years of age. The Journal of Pediatrics, 55, 679-690.

Hess, J. H. (1953). Experiences gained in a thirty-year study of prematurely born infants. Pediatrics, 11, 425-434.

Holt, K. (1972). Problems in the young. Proceedings of the Royal Society of Medicine, 65, 204-206.

Howard, P. J., Worrell, W., & Colier, H. (1952). Premature infants in later life: Study of intelligence and personality of 22 premature infants at ages 8 to 19 years. Pediatrics, 9, 577-584.

Huck, S., Cormier, W., & Bounds, Jr., W. (1974). Reading statistics and research. New York: Harper and Row.

Hunt, J. V. (1979). Longitudinal research: A method for studying the intellectual development of high-risk preterm infants. In T. Fields, A. M. Sostek, S. Goldberg, & H. H. Schuman (Eds.), Infants born at risk: Behavior and development (pp. 443-459). New York: Spectrum Publications.

Hunt, J. V. (1981). Predicting intellectual disorders in childhood for preterm infants with birthweights below 1501 grams. In S. L. Friedman & M. Sigman (Eds.), Preterm birth and psychological development (pp. 329-351). New York: Academic Press.

Illingworth, R. S. (1980). The development of the infant and young child: Normal and abnormal. New York: Churchill Livingstone.

Issac, S., & Michael, W. (1981). Handbook in research and education (2nd ed.). San Diego: ITS Publishers.

Jacob, S., Benedict, H. E., Roach, J., & Blackledge, G. L. (1984). Cognitive, perceptual and personal-social development of prematurely born pre-schoolers. Perceptual and Motor Skills, 58, 551-562.

Johnson, J., Malachowski, N. C., Grobstien, R., Welsh, D., Daily, W., & Sunshine, P. (1974). Prognosis of children surviving with the aid of mechanical ventilation in the newborn period. Journal of Pediatrics, 84, 272-276.

Jones, R. A. K., Cummins, M., & Davies, P. (1979). Infants of very low birthweight: A 15 year analysis. Lancet, 1, 1332-1338.

Kawi, A., & Pasamanick, B. (1959). Prenatal and perinatal factors in the development of childhood reading disorders. Monographs of the Society for Research in Child Development, 4 (Serial No. 73).

Keller, C. (1981). Epidemiological characteristics of preterm birth. In S. Friedman & M. Sigman (Eds.), Preterm birth and psychological development (pp. 3-16). New York: Academic Press.

Kerlinger, F. N. (1973). Foundations of behavioral research (2nd ed.). New York: Holt, Rinehart, and Winston, Inc.

Kerlinger, F. N., & Pedhauser, E. J. (1973). Multiple regression in behavioral research. New York: Holt, Rinehart, and Winston, Inc.

Kitchen, W. H., Rickards, A., Ryan, M. M., McDougall, A. B., Billson, F. A., Keir, E. H., & Naylor, F. D. (1979). A longitudinal study of very low birthweight infants. II: Results of controlled trial of intensive care and incidence of handicaps. Developmental Medicine and Child Neurology, 21, 582-589.

Kitchen, W. H., Ryan, M. M., Rickards, A., Gaudry, E., Benton, A. M., Billson, F. A., Fortune, D. W., Keir, E. H., & Lundahl-Hegedus, E. E. (1978). A longitudinal study of very low birthweight infants. I: Study design and mortality rates. Developmental Medicine and Neurology, 20, 605-618.

Kitchen, W. H., Ryan, M. M., Rickards, A., McDougall, A. B., Billson, F. A., Keir, E. H., & Naylor, F. D. (1980). A longitudinal study of very low birthweight infants. IV: An overview of performance at eight years of age. Developmental Medicine and Child Neurology, 22, 172-188.

Klienman, J. C., Kovar, M. G., Feldman, J. J., & Young, C. A. (1978). A comparison of 1960 and 1973-74 early neonatal mortality in selected states. American Journal of Epidemiology, 108, 454-460.

Koeing, H. (1950). What happens to prematures? American Journal of Public Health, 40, 803-807.

Lee, K. S., Paneth, N., Gartner, L. H., Perlman, M. A., & Gruss, L. (1980). Neonatal mortality: An analysis of recent improvement in the United States. American Journal of Public Health, 70, 15-21.

Light, H. W. (1981). Parent guide to grade retention (to accompany Light's Retention Scale). Navato, CA: Academic Therapy.

Lilenfield, A. M., & Parkhurst, E. (1951). A study of the association of the factors of pregnancy and partuition with the development of cerebral palsy. American Journal of Hygiene, 53, 262-270.

Littman, B. (1979). The relationship of medical events to infant development. In T. Martini, A. M. Sostek, S. Goldberg, & H. H. Shuman (Eds.), Infants born at risk: Behavior and development (pp. 53-65). New York: Spectrum Publications.

Lubchenco, L. O. (1970). Assessment of gestational age and development at birth. Pediatric Clinics of North America, 17, 125-145.

Lubchenco, L. O. (1980). Morbidity and mortality in neonatal intensive care units. In E. J. Sell (Ed.), Follow-up of the high risk newborn: A practical approach (pp. 3-13). Springfield, IL: Charles C. Thomas.

Lubchenco, L. O. (1983). The developmental outcome of premature infants. In G. Smith, D. Vidyasagar, & P. Smith (Eds.), Historical review and recent advances in neonatal and perinatal medicine: Vol. 2, (pp. 125-138). Sommerville, NJ: Mead-Johnson Nutritional Division.

Lubchenco, L. O., Delivoria-Popadopoulos, M., & Searls, D. (1972). Longterm follow-up studies of prematurely born infants. II. Influence of birthweight and gestational age on sequelae. Journal of Pediatrics, 80, 509-512.

Lubchenco, L. O., Horner, F. A., Reed, L. H., Hix, I. E., Metcalf, D., Cohig, R., Elliot, H. C., & Bourg, M. (1963). Sequelae of premature birth: Evaluation of premature infants of low birth weights at ten years of age. American Journal of Diseases of Childhood, 106, 106-115.

Markestad, T., & Fitzhardinge, P. M. (1981). Growth and development of children recovering from BPD. Journal of Pediatrics, 98, 597-602.

Marriage, K. J., & Davies, P. A. (1977). Neurological sequelae in children surviving mechanical ventilation in the neonatal period. Archives of Diseases in Childhood, 52, 176-182.

Menkes, J. H., Welcher, D. W., Levi, H. S., Dallas, J., & Gretsky, N. E. (1972). Relationship of elevated trysoine to the ultimate intellectual peformance of premature infants. Pediatrics, 49, 218-224.

McDonald, D. (1963). Cerebral palsy in children of very low birthweight. Archives of Diseases in Childhood, 38, 579-588.

McNemar, Q. (1962). Psychological statistics (3rd ed.). New York: John Wiley and Sons.

Morh, G. J., & Bartelme, P. F. (1934). Developmental studies of prematurely born children. In J. H. Hess, C. J. Morh, & P. F. Bartelme (Eds.), The physical growth and mental growth of prematurely born children (pp. 57-217). Chicago: University of Chicago Press.

Northway, W. H. (1979). Observations on bronchopulmonary dysplasia. Journal of Pediatrics, 95, 873-878.

Nurss, J., & McGauvran, M. (1976). Teacher's manual part II: Interpretation and use of test results. New York: Harcourt, Brace, and Jovanovich.

Outerbridge, E. W., Ramsay, M., & Stern, L. (1974). Developmental follow-up of survivors of neonatal respiratory failure. Critical Care Medicine, 2, 23-27.

Paneth, N., Kiely, J. L., Stein, Z., & Susser, M. (1981). Cerebral palsy and newborn care. III: Estimates prevelance rates of cerebral palsy under differing rates of mortality and impairment of low-birthweight infants. Developmental Medicine and Child Neurology, 23, 801-817.

Pape, K., Bunic, R. J., Ashby, S., & Fitzhardinge, P. M. (1978). The status at two years of low-birth-weight infants born in 1974 with birth weights of less than 1000 gm. Journal of Pediatrics, 92, 253-260.

Piaget, J. (1970). Piaget's theory. In P. Mussed (Ed.), Charmichael's manual of child psychology: Vol. II, (3rd ed.) (pp. 703-732). New York: John Wiley and Sons.

Raju, T. N. K. (1983). Some famous "high risk" newborn babies. In G. F. Smith, D. Vidyasagar, & P. N. Smith (Eds.), Historical review and recent advances in neonatal and perinatal medicine: Vol. II, (pp. 186-189). Sommerville, NJ: Mead Johnson Nutritional Division.

Resnick, M. B., Bauer, C., Cupoli, M., Ausbon, W. W., Evans, J., and Regionalized Perinatal Staff (1983a). Florida regional perinatal intensive care program development evaluation component--Early developmental outcome. Journal of the Florida Medical Association, 70, 833-838.

Resnick, M. B., Eitzman, D., Dickman, H., Ariet, M., Ausbon, W. W., & Mahan, C. S. (1983b). Data base management system for Children's Medical Regional Perinatal Intensive Care Centers Program. Journal of the Florida Medical Association, 70, 718-721.

Robertson, E. G. (1979). Prenatal factors contributing to high-risk offspring. In T. Martini, A. M. Sostek, S. Goldberg, & H. H. Schman (Eds.), Infants born at risk: Behavior and development (pp. 3-15). New York: Spectrum Publications.

Robinson, N. M., & Robinson, H. B. (1965). A follow-up study of children of low birth weight and control children at school age. Pediatrics, 35, 425-433.

Rosanoff, A., & Inman-Kane, C. (1934). Relation of premature birth and underweight conditions at birth to mental deficiency. American Journal of Psychiatry, 13, 829-852.

Rubin, R. A., Rosenblatt, C., & Balow, B. (1973). Psychological and educational sequelae of prematurity. Pediatrics, 52, 352-363.

Schiebler, G., & Freedman, S. (1983). Regionalized neonatal/perinatal intensive care center program: A political history. Journal of the Florida Medical Association, 70, 704-707.

School Board of Alachua County, Florida Department of Education, Division of Public Schools, Bureau of Education for Exceptional Students (1985). Special programs and procedures for exceptional students. Gainesville, FL: The Alachua County Printing Office.

Schroeder, C., Teplin, S., & Schroeder, S. R. (1982). An overview of common medical problems encountered in schools. In C. R. Reynolds and T. B. Gutkin (Eds.), The handbook of school psychology (pp. 971-1008). New York: John Wiley and Sons.

Silva, P. A., McGee, R., and Williams, S. (1984). A longitudinal study of the intelligence and behavior of pre-term and small-for-gestational-age children. Journal of Developmental and Behavioral Pediatrics, 5, 1-5.

Smith, A. C., Flick, G. L., Ferriss, G., & Sellman, A. H. (1972). Prediction at seven years from prenatal, perinatal, and postnatal events. Child Development, 43, 495-507.

Stahlman, M. T., Hedval, G., Dolanski, I., Faxelius, G., Burko, H., & Kirk, V. (1973). A six-year follow-up of clinical hyaline membrane disease. Pediatric Clinics of North America, 20, 443-446.

Steiner, E. S., Sanders, E. M., Phillips, E. C. K., & Maddock, C. R. (1980). Very low birth weight children at school age: Comparison of neonatal management methods. British Medical Journal, 281, 1237-1240.

Stewart, A. (1972). The risk of handicap due to birth defect in infants of very low birthweight. Developmental Medicine and Child Neurology, 14, 585-591.

Stewart, A., & Reynolds, E. O. R. (1974). Improved prognosis for infants of very low birthweight. Pediatrics, 54, 724-735.

Stewart, A., Reynolds, E. O. R., & Lipscomb, A. P. (1981). Outcome for infants of very low birthweight: Survey of world literature. Lancet, 1, 1038-1041.

Stewart, A., Turcan, D., Rawlings, G., Hart, S., & Gregory S., (1978). Outcome for infants at high risk of major handicap. Critical Care Medicine, 16, 151-171.

Stewart, A., Turcan, D. M., Rawlings, G., & Reynolds, E. O. R. (1977). Prognosis for infants weighing 1000g or less at birth. Archives of Diseases in Childhood, 52, 97-104.

Swanson, H. L., & Watson, B. L. (1982). Educational and psychological assessment of exceptional children. St. Louis: C. V. Masby Co.

Takkunen, R.-L., Frisk, M., & Holmstrom, M. G. (1963). Small prematures at 6-7 years of age. I: Developmental status. Annales Paediatriae Fenniae, 9, 183-196.

Taub, H. B., Goldstien, K. M., & Caputo, D. (1977). Indicies of neonatal prematurity as discriminators in middle childhood. Child Development, 48, 797-805.

Unger, J., & Sigman, M. (1983). Developmental lags in preterm infants from one to three years of age. Child Development, 54, 1217-1228.

United States Department of Commerce, Bureau of Census (1985). Statistical Abstracts of the United States. Washington, DC: U. S. Government Printing Office.

United States Department of Health, Education, and Welfare, Public Health Service, National Center for Health Statistics. Vital statistics of the United States 1973: Vol. 1--Natality. Washington, DC: U. S. Government Printing Office.

Vidyasagar, D. (1983). Historical perspectives and recent advances of neonatal monitoring. In G. Smith, D. Vidyasagar, & P. Smith (Eds.), Historical review and recent advances in neonatal and perinatal medicine, Vol. II (pp. 45-61). Sommerville, NJ: Mead-Johnson Nutritional Division.

Vohr, B., Bell, E. F., & Oh, W. (1982). Infants with bronchopulmonary dysplasia. American Journal of Diseases of Children, 136, 443-447.

Weiner, G. (1962). Psychological correlates of premature birth: A review. Journal of Nervous and Mental Disease, 134, 129-144.

Weiner, G. (1968). Scholastic achievement at age 12-13 of prematurely born infants. Journal of Special Education, 2, 237-251.

Weiner, G., Rider, R., Oppel, W., Fischer, L., & Harper, P. (1965). Correlates of low birth weight: Psychological status at six to seven years of age. Pediatrics, 35, 434-444.

Weiner, G., Rider, R., Oppel, W., & Harper, P. (1968). Correlates of low birth weight: Psychological status at eight to ten years of age. Paediatric Research, 2, 110-118.

Wolf, R. (1978). Review of the Metropolitan Achievement Tests. In O. K. Buros (Ed.), The mental measurements yearbook (8th ed.) (pp. 67-71). Highland Park, NJ: Gryphon Press.

Wright, F. H., Blough, R. R., Chamberlin, A., Ernest, T., Halstead, W. C., Meier, P., Moore, R. Y., Nauton, R. F., & Newell, F. W. (1972). A controlled follow-up study of small prematures born from 1952 through 1956. American Journal of Diseases of Children, 124, 507-521.

Yu, V. Y. H., & Hollingsworth, E. (1979). Improving prognosis for infants weighing 1000 grams or less at birth. Archives of Diseases in Childhood, 55, 422-426.

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Kathryn Funke Gould was born February 23, 1951, in Hoershing, Austria. After her father retired from military service, her family moved to Tampa, Florida, in 1965. She received a B.A. degree in education from the University of Florida in 1973. After being employed as a social worker in child welfare, she returned to the University of Florida to specialize in school psychology. She received her M.Ed. and Ed.S. degrees in 1982. She is currently certified and licensed as a school psychologist in the state of Florida. She plans to continue to work part-time in a developmental clinic for high-risk infants and children while pursuing a private practice in Gainesville, Florida, following the completion of her Ph.D.

I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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